Observing Scenarios

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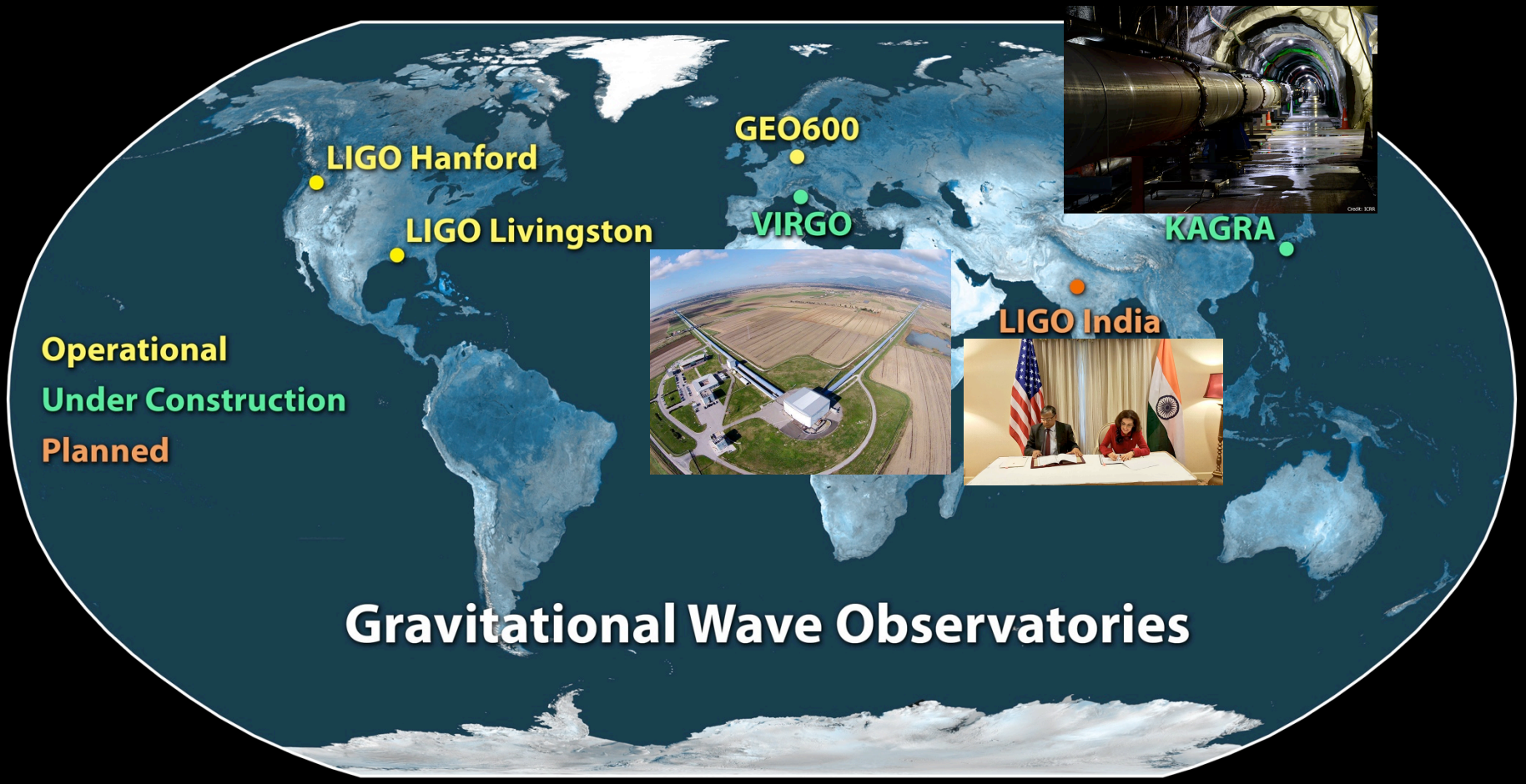
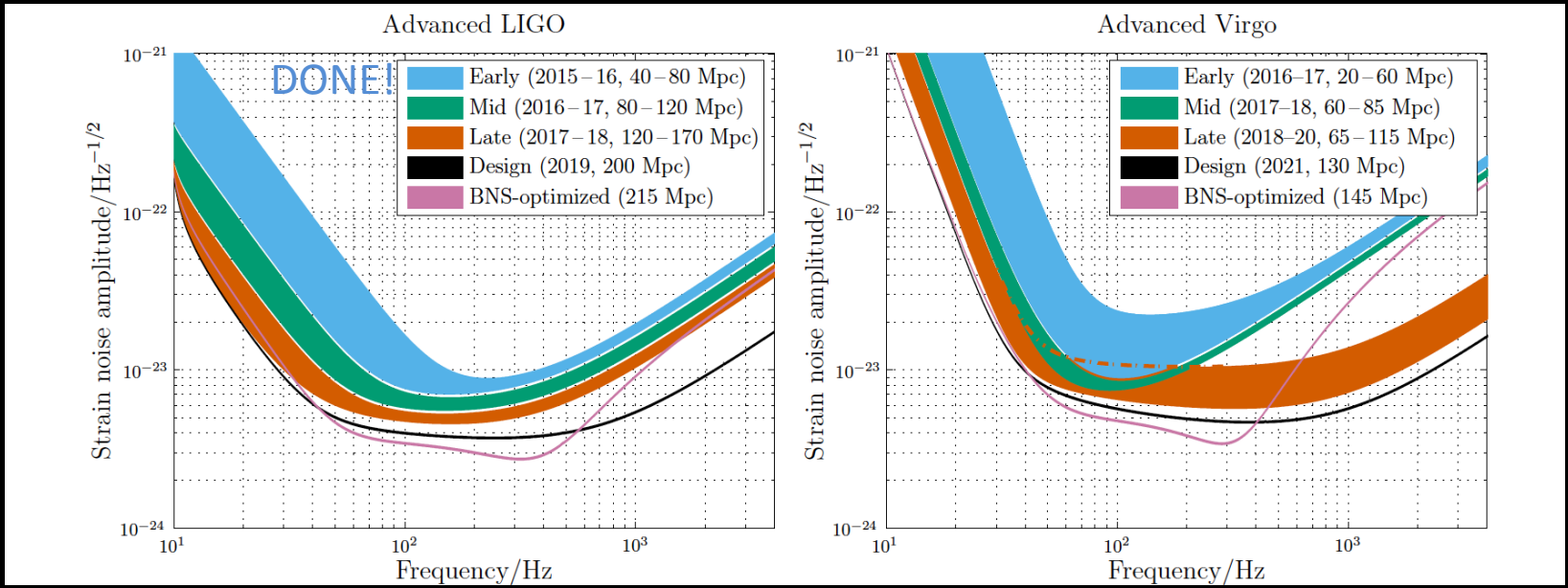
This talk: “post-O3 scenarios, how upgrades and data taking can be managed for best science, including Virgo and Kagra timeline, expectations on evolution of their sensitivities, and prospects for LIGO-India”



Observing Plan - Overview



2015–2016 (O1) A four-month run (beginning 18 September 2015 and ending 12 January 2016) with the two-detector H1L1 network at early aLIGO sensitivity (40–80 Mpc BNS range).

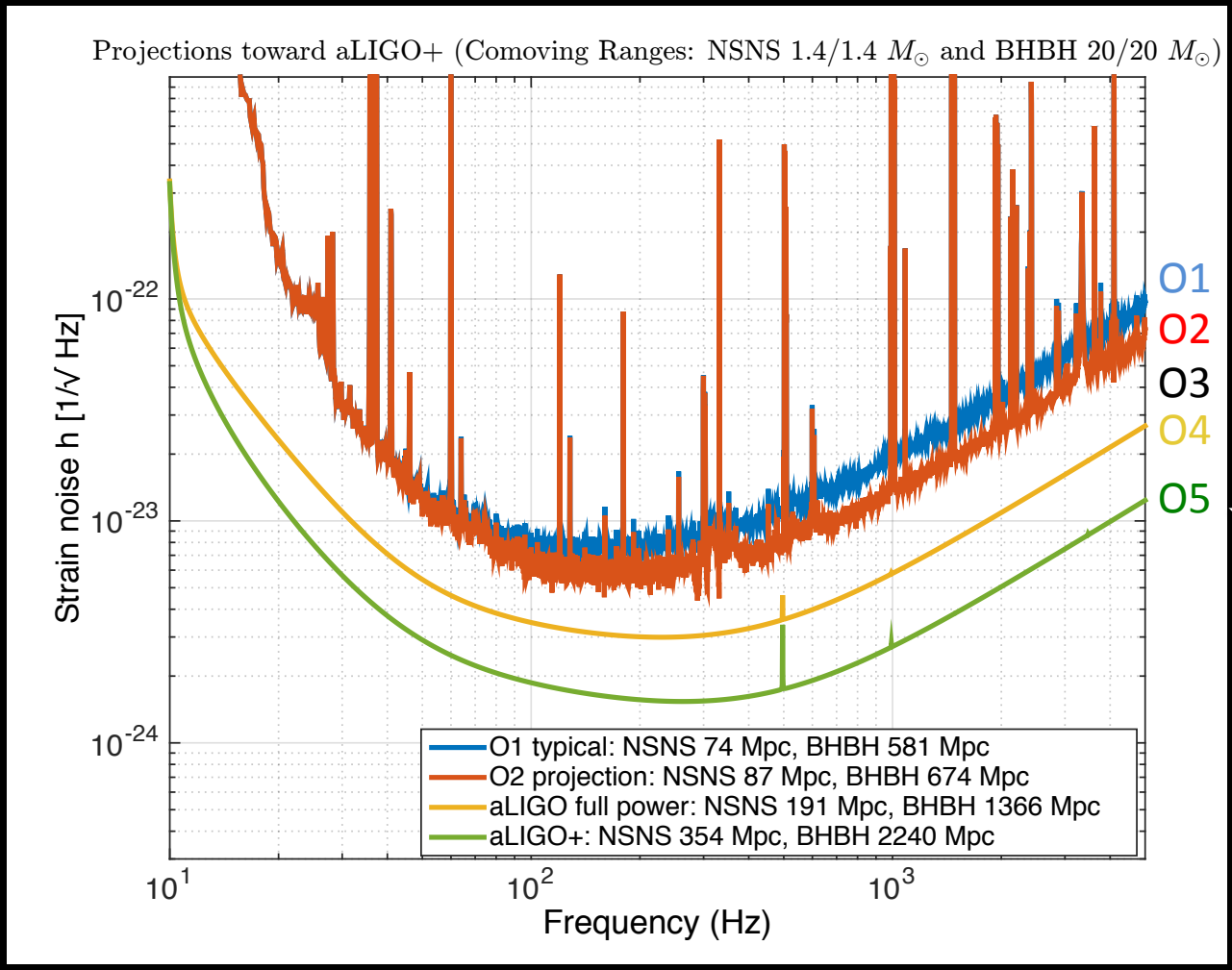
2016–2017 (O2) A six-month run with H1L1 at 80–120 Mpc and V1 at 20–60 Mpc.

2017–2018 (O3) A nine-month run with H1L1 at 120–170 Mpc and V1 at 60–85 Mpc.

2019+ Three-detector network with H1L1 at full sensitivity of 200 Mpc and V1 at 65–115 Mpc.

Live Observing document http://arxiv.org/abs/1304.0670

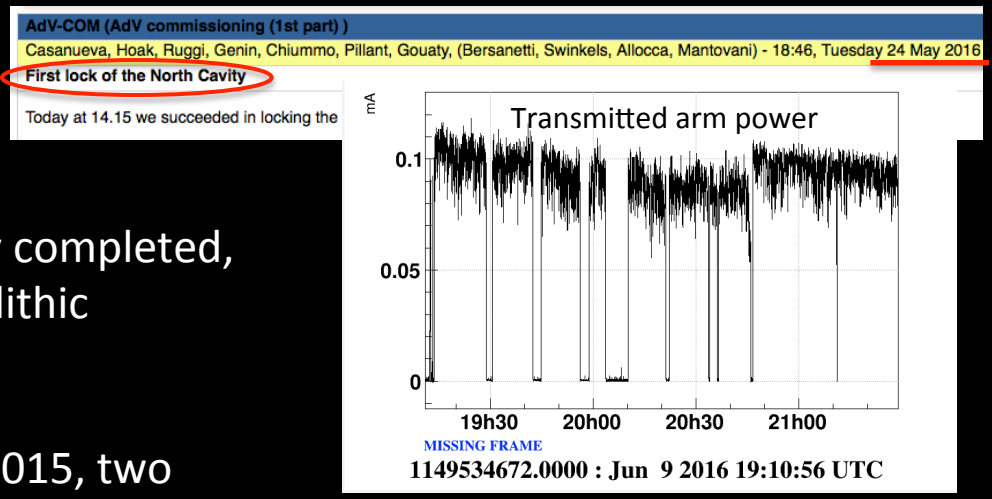
LIGO Sensitivity Projections



Increasing sensitivity and run duration

Advanced VIRGO

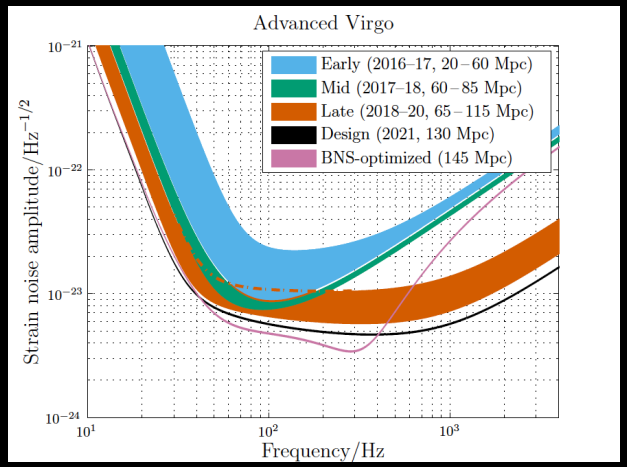
- First lock of one of the 3km long arms achieved in May!



- Installation and integration nearly completed, but challenges in operating monolithic suspensions under vacuum

- Several failures since November 2015, two happened very recently:
  - Root cause not yet understood
  - Dedicated test facility for investigations;
  - Commissioning will progress with steel wires for 4 core optics

- VIRGO expected to join O2 in 2017; should still meet minimal 20 Mpc goal



KAGRA

- 3km underground detector designed for cryogenics operation (20K, sapphire test masses)
- Simple Michelson, room temperature locked in March
- Sensitivity progression and observing scenario under discussion within the KAGRA collaboration:
  - 3 phases, interferometer configuration progressing in complexity
  - Recent schedule: cryogenics operations late 2018/early 2019
    (credit: M Ando, S. Miyoki)
  - Expected to join observations in early 2020
- Broader discussion with LIGO-VIRGO collaborations in the fall

Prospects from LIGO-INDIA (credit: Fred Raab)

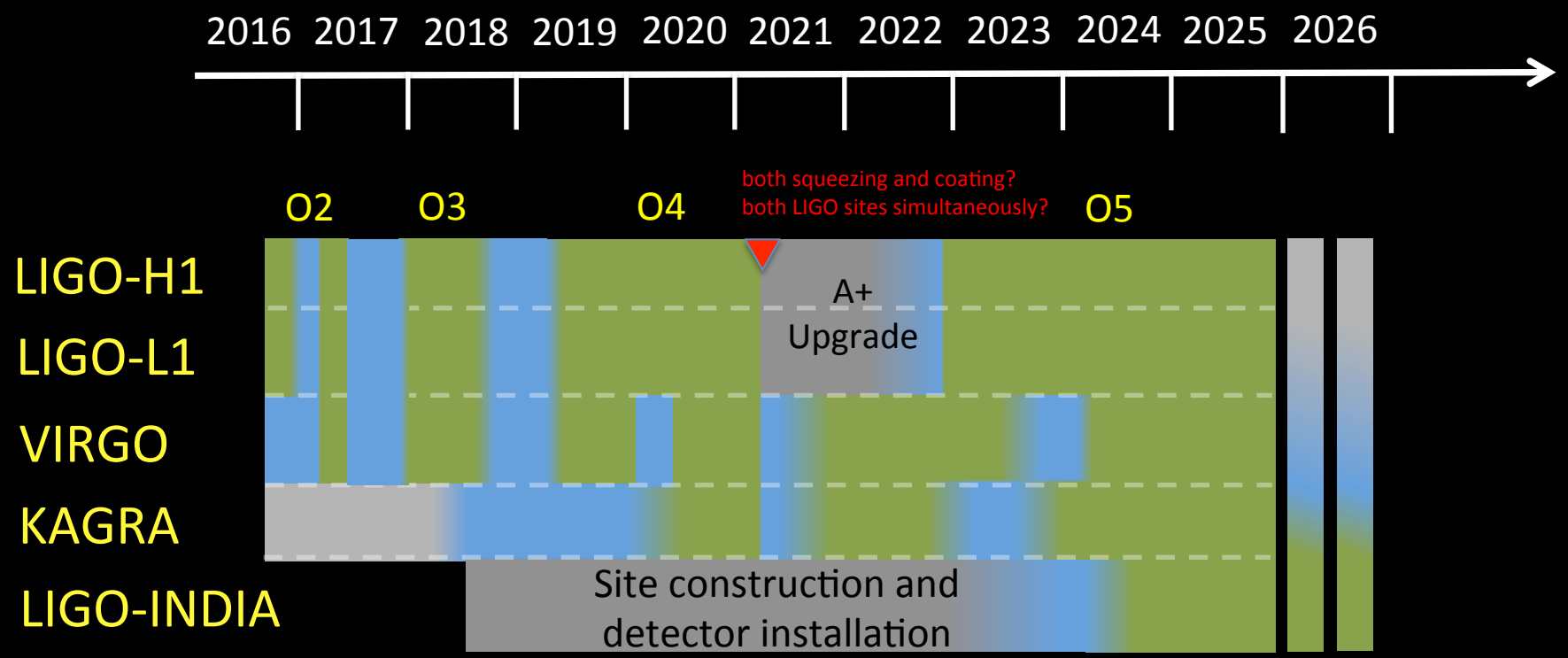
- "In-principle" approval on Feb 17, 2016
- Site selection has converged on a prime site – expectation of imminent formal selection
- Vacuum infrastructure drawings completed
- Project schedule developed:
  - Consistent with observations beginning in Jan 2024 (assumes no technical or other delays)

Some general guidelines for run planning

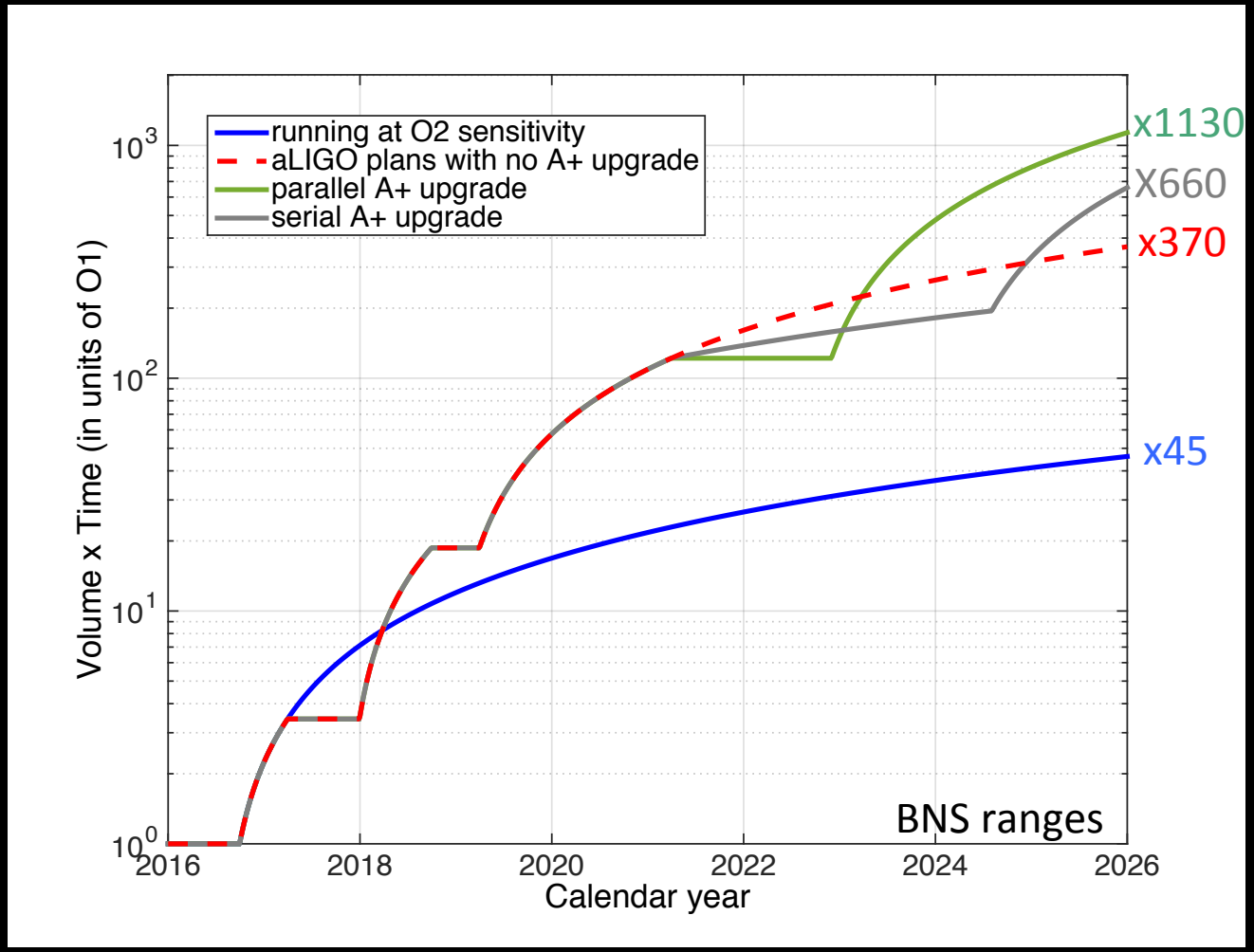
- Given O1 results, aLIGO-O1 sensitivity is benchmark for detection
- From Leo's conclusions:
  - The detection rate is set by the range of the second most sensitive detector;
  - For *sky localization*, third detector contributes even if a *factor of 4* less sensitive than most sensitive detector.

Plausible world-wide observing scenario for the next decade

Observing time
Commissioning time
Downtime for upgrades



Volume x Time with different scenarios



Some preliminary messages and discussion point - I

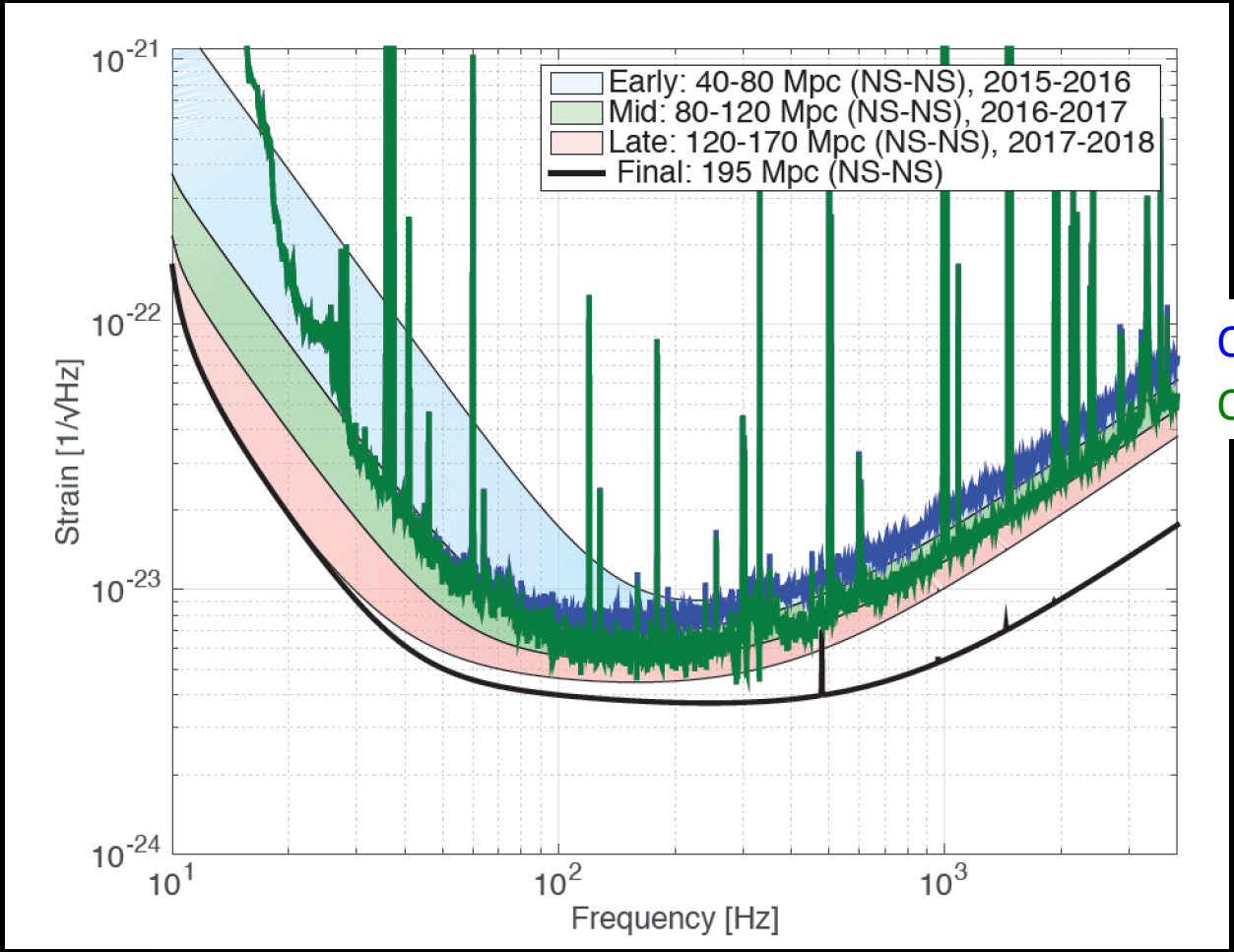
- Expectation is to maximize coincidence across the network in the next few years
  - improved sky localization
  - when Virgo, Kagra have aLIGO-O1 like sensitivity could consider other options
- A+ upgrade:
  - maximize scientific output if done in parallel at both sites
  - “serial” upgrade would rely on Virgo, Kagra for detection
  - same A+ technologies offer enhancement opportunities for the whole network

Some preliminary messages and discussion points - II

- Timeline suggests that LIGO-INDIA should plan now for a fast progression toward an A+ detector
  - early plans for a filter cavity infrastructure
  - leverage on progress in coating research for A+ (additional test mass substrates to be coated when improved coating options available)
- LIGO-INDIA will add flexibility to the network for major Voyager-like upgrades

Extra Slides

Advanced LIGO in O1 and prospects for O2



LIGO Concept Roadmap

(Mike's talk, adapted from G1401081)