Update on Run Planning

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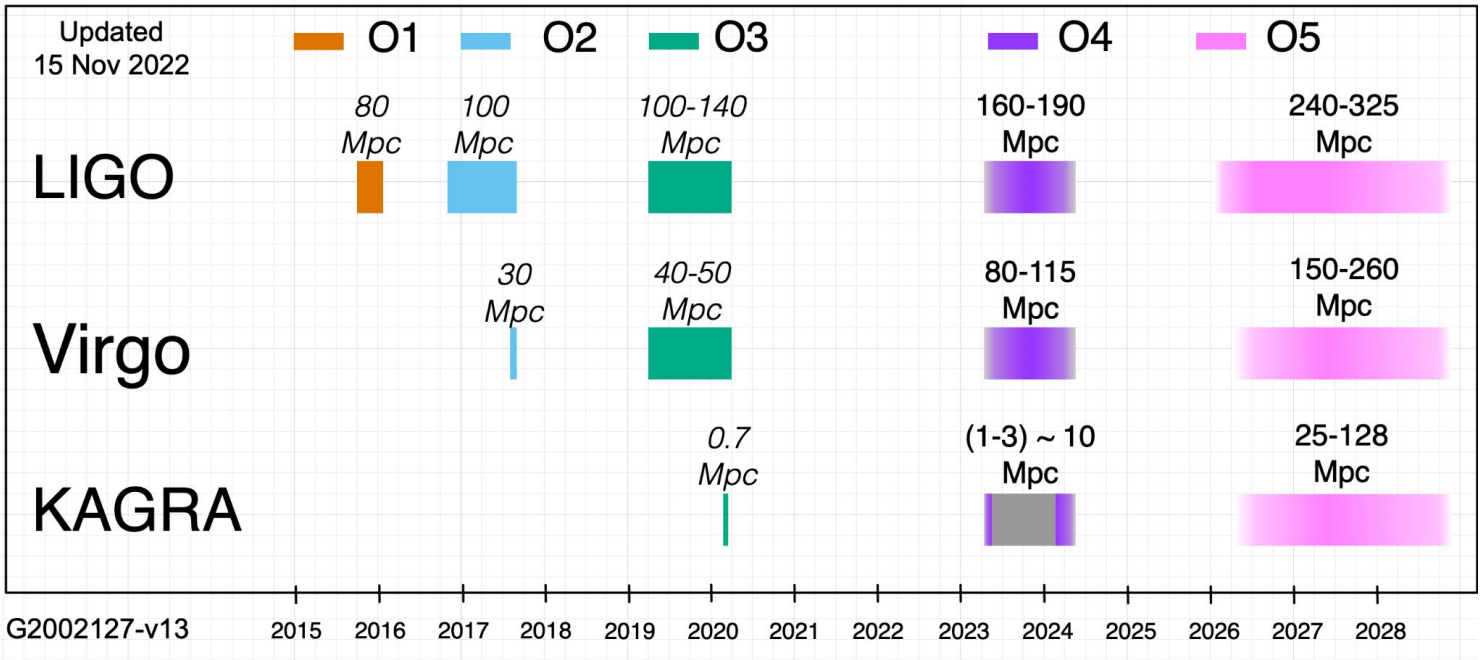
https://dcc.ligo.org/G2202196

Observing plans



LIGO-Virgo-KAGRA anticipate observing to dovetail with next generation facilities

Observing plans are now being maintained at https://observing.docs.ligo.org/plan/

Review of run plans

- Our ability to start O4 in March 2023 is currently under review.
- How the planning process works:
  - Observatory projects (LIGO Lab, Virgo, KAGRA) manage upgrades.
  - They are currently reviewing progress towards O4 readiness.
  - They are currently generating a revised, realistic schedule for the remaining work.
  - Input from LVK & community members on science goals and impact is being considered.
    - See the next slides
  - The LVK Joint Run Planning Committee (JRPC) will meet in mid January to digest the updated information and decide on changes to the run plan.
  - The decisions are generally published on https://observing.docs.ligo.org/plan/ within a few days of the JRPC meeting.

What is being addressed

- Unanticipated delays in construction and other activities are translating into a delay to the start of O4
  - Decision in January; **<u>might</u>** be up to a couple of months of delay in start of O4.
- Readiness to do the upgrades for O5 is being reviewed:
  - Improved mirror coatings are needed to reach the best O5 sensitivity.
  - An R&D program is ongoing and it might benefit from additional time to reach fruition.
  - This is being considered by LIGO and Virgo.
  - We are therefore considering an extension of the O4 run
    - No concrete proposal yet. Beginning to look at +3,+6, +9,+12 months.
- The LVK puts a great deal of effort into working together to optimize the scientific impact of the global network.

Multimessenger considerations

- Ryan Foley's presentation on 22 September 2022
  - The anticipated rate of gravitational-wave + kilonova detections at O4 LVK sensitivities may be less than 1/year at O4 sensitivities.
  - Going from 1 year to 1.5 years of O4 would increase the probability of detecting a kilonova from 0.7 to 0.9; going from 1.5 years to 2 years would increase the probability to only 0.95.
- Kilonova detection is limited to O4 volume with current telescopes
  - Observers should coordinate their observations to optimize the scientific impact
    - Mirroring the effort the LVK puts into coordinating observing and publishing alerts.
  - Improvements in localization by gravitational-wave detectors is important, Virgo O5.
- Knowing when the gravitational-wave network will be observing is extremely important when proposing new space missions, eg GRB missions.
  - The LVK is examining ways to improve the reliability of future run date prediction.

Other science goals

- Other high-priority LVK goals include
  - elucidating aspects of stellar evolution through studies of compact binary mergers detected by the LVK, studying cosmology using the large number of dark compact binary mergers, understanding the equation of state of dense matter, and testing general relativity.
- As a new field of gravitational-wave astronomy, improving the instrumental sensitivity will eventually lead to:
  - The detection of continuous gravitational-wave sources (e.g. isolated neutron stars in the Milky Way), the detection of stochastic gravitational-wave backgrounds (e.g from the compact binary merger population across the Universe and eventually from the early Universe), and correlated detections of cosmological neutrino and gravitational-wave sources.
- These elements of our scientific program motivate a push to get to the A+/V+ design sensitivities expected for the O5 observing run.

General information

- OpenLVEM Wiki
  - https://wiki.gw-astronomy.org/OpenLVEM/
  - Gateway to more information
- Mailing list
  - Please sign up to the public openlvem mailing list; anyone can subscribe
  - Instructions at https://wiki.gw-astronomy.org/OpenLVEM
  - We will use it to announce changes of configuration, plans, etc
  - https://wiki.gw-astronomy.org/OpenLVEM/Telecon20220721
- Framework for communications
  - We will arrange online meetings every 4 to 6 weeks to share updates and to hear from others about plans and ideas for using alerts.
  - During O4, we will arrange regular online meetings to provide updates on detector operations, data quality, interpretation of alerts and to discuss any changes in plans. Initially, once a week, settling to once per month or so.

For question time

Trading Sensitivity and Observing Time

- Crude extrapolation to O4 and O5 assuming BNS range of second most sensitive detector and similar duty cycle and performance to O3.
- Other science
  - Improved SNR
  - New sources?