

Public Alerts

LIGO-Virgo Low-latency Analysis Group

All you need to know

- LIGO/Virgo will release alerts in low latency for transient event candidates
 - These alerts will be publicly available through the Gamma-ray Coordinates Network (GCN)
 - Event candidates will be publicly available in <https://gracedb.ligo.org>
 - MDC events are there now: [search “category: MDC”](#)
 - There will be no human vetting for the **Preliminary** alert
- LIGO/Virgo Public Alerts User Guide & Support
 - <https://emfollow.docs.ligo.org/userguide/quickstart.html> (thanks to Leo Singer, Sarah Antier, Shaon Ghosh, Shasvath Kapadia, Geoffrey Mo, Karelle Siellez, Om Salafia, Deep Chatterjee and Duncan Meacher)
 - contact+emfollow/userguide@support.ligo.org
 - Version 3 released: <https://emfollow.docs.ligo.org/userguide/changes.html>

Important information

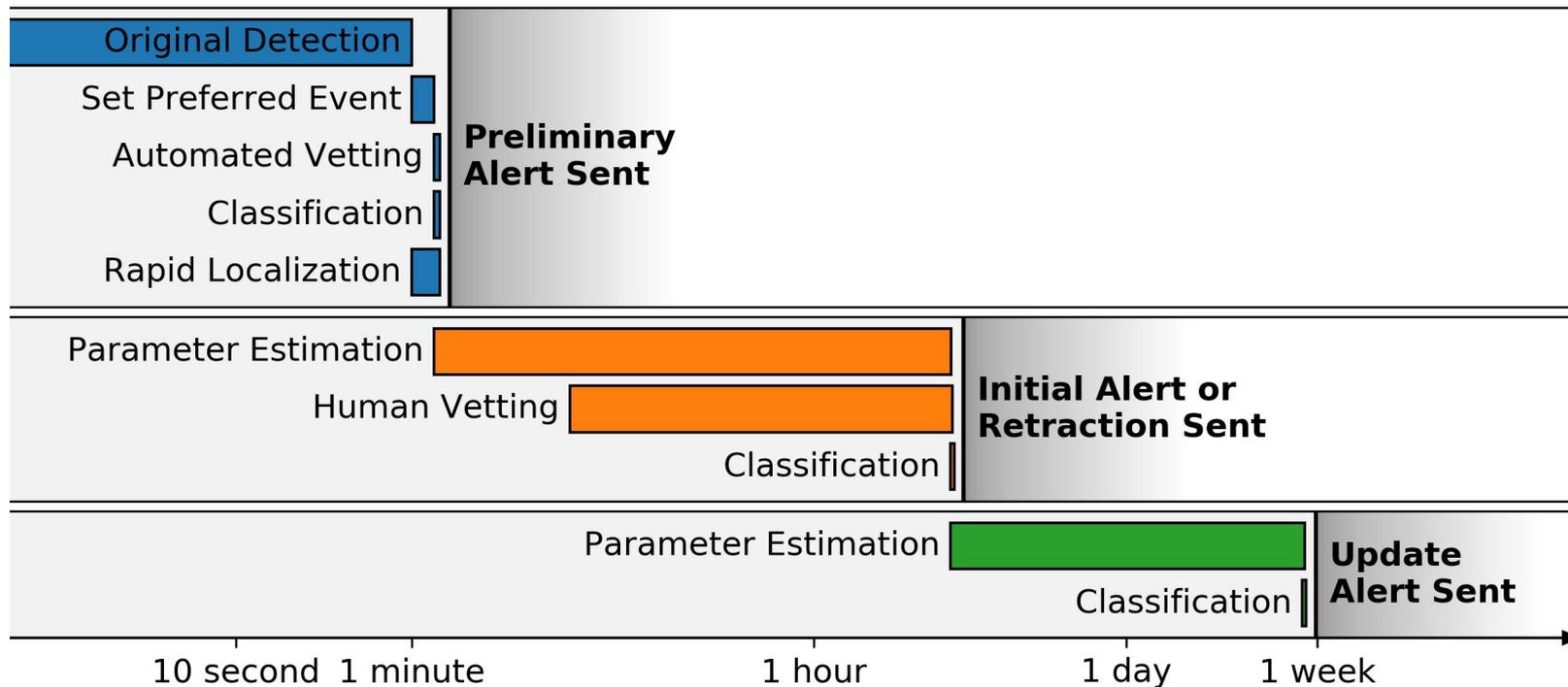
- Mailing list
 - Please sign up to the openlvem mailing.
 - Instructions at <https://wiki.gw-astronomy.org/OpenLVEM>
 - This is a public list to which anyone can subscribe
 - We will use it to announce changes of configuration, plans, etc

- EM observations in gracedb
 - No public annotations are allowed
 - LVC is not currently planning to provide this service

Updated Detection Rate Estimates for O3

- Binary neutron stars (BNS)
 - Up to 1/month of data taken; median is 2/year of data taken
 - Median 90% credible localization 120-180 deg²; 12-21% localized < 20 deg²
- Binary black holes (BBH)
 - 1/month to 1/week of data taken
- Neutron-star black-hole binaries (NSBH)
 - Uncertain, estimates include zero
- Other transients
 - Unknown
- **LIGO-Virgo target contamination of public alerts**
 - **Contamination ~10% of public alerts across all categories together**
 - **BNS, NSBH & other transients may individually have higher contamination**

GCN Notice times after a gravitational-wave signal



Time-coincidence with external triggers

- RAVEN search pipeline continuously monitors for time (and spatial overlap) coincidence between all gravitational-wave triggers submitted to gracedb and external triggers (e.g. neutrinos, gamma-ray bursts,..)
 - Alerts will be issued if the combined false-alarm-rate meets criteria given earlier
 - Single detector gravitational-wave triggers may lead to such alerts
- At any time, we may promote an extraordinary candidate that does not pass the automated analysis criteria
 - **Note:** Initial notices and circulars will be distributed, but a preliminary alert may not be !

Localization and Inference

- Rapid 3D localization is ready in seconds
 - Distributed in FITS file as a HEALPix all-sky image
- Classification of CBC alerts
 - The classification consists of five numbers, summing to unity, that give the probability that the source is a BNS, NSBH, BBH, Gap (components in 3-5 Msun) merger, or terrestrial (i.e. a background fluctuation or a glitch).
- Properties
 - A set of numbers, each between zero and unity, that give the probabilities that the source
 - HasNS: At least one of the compact objects in the binary has a mass that is consistent with a neutron star (i.e. $m_2 \leq 3M_\odot$).
 - HasRemnant: Source ejected a nonzero mass outside the final remnant compact object.

Time to public alerts in O3

- End to end test at the beginning of March
- ER14: public alerts after human vetting for interesting candidates
- O3: transition to automated alerts at the start of O3
- Tests and transitions will be announced on the openlvem mailing list
 - a. Watch that space as we approach the run

Alert contents

<https://emfollow.docs.ligo.org/userguide/content.html>

Superevents

- Multiple pipelines running over data
 - CBC: gstlal, mbta, pycbc, spiiir carry out matched filter searches for compact binaries
 - Burst: cwb, olib carry out searches for unmodeled transients
- Superevents
 - A new abstraction to unify gravitational-wave candidate events from multiple pipelines
 - One superevent per physical transient
 - One candidate event within a superevent is identified as the preferred event from which significance, localization, classification, ... are inherited by the superevent
- Preferred event selection
 - multiple interferometer candidates are preferred over single interferometer candidates
 - CBC candidates are preferred over Burst candidates
 - The highest signal to noise ratio (SNR) CBC candidate is preferred.
 - The lowest false alarm rate (FAR) Burst candidate is preferred in a Burst-only superevent