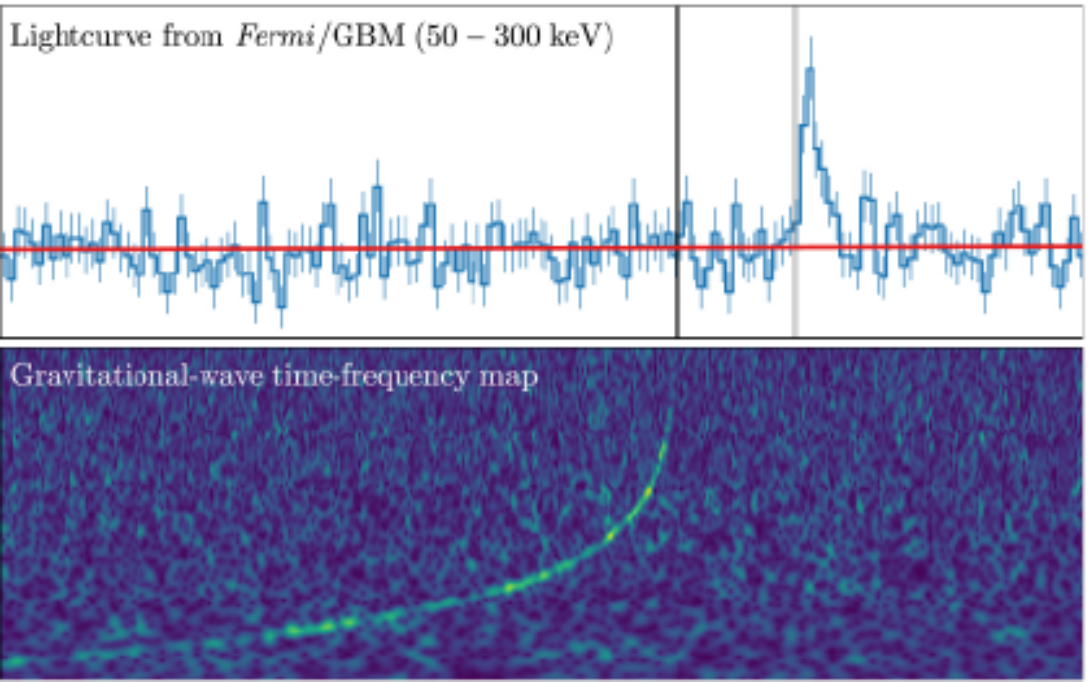
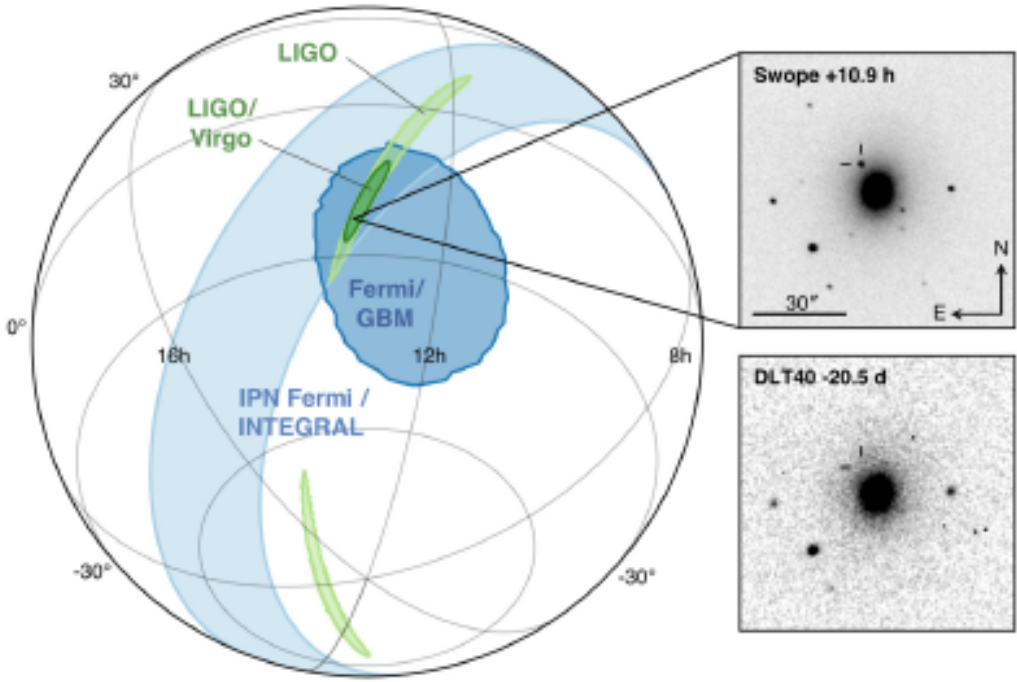
Open LIGO-Virgo alerts

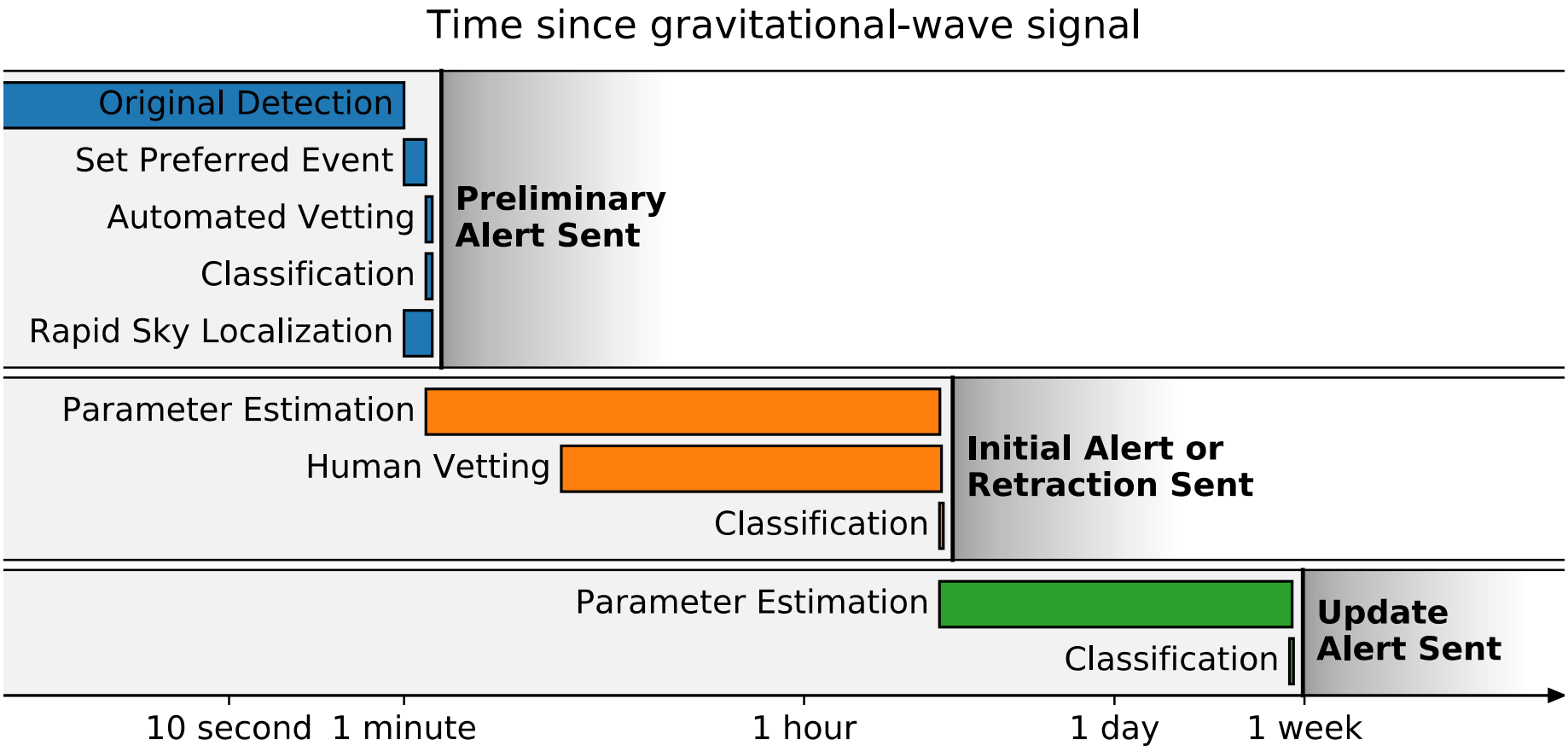
LSC LIGO Scientific Collaboration

VIRGO

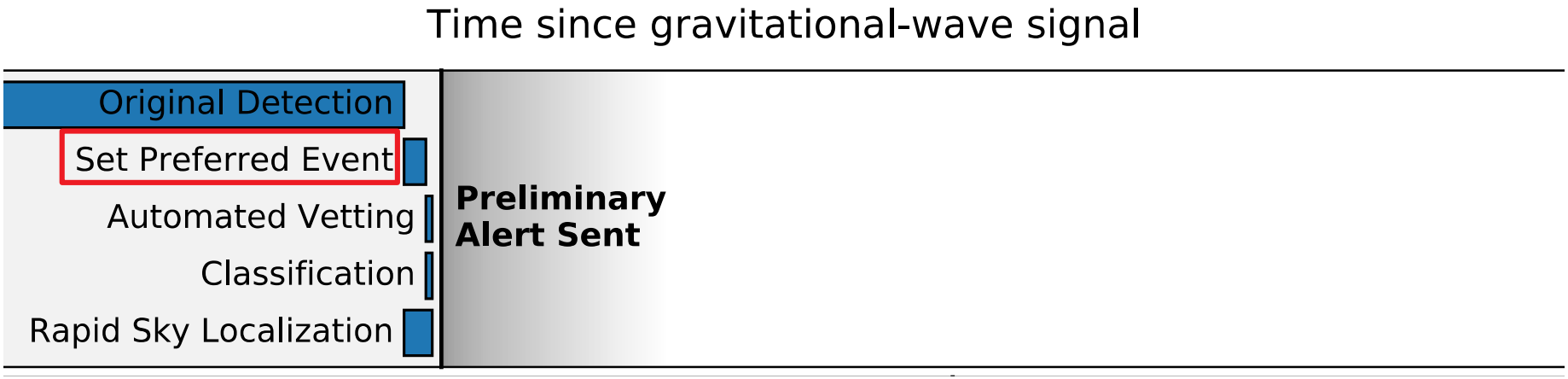




Timeline


Time since gravitational-wave signal
Original Detection
Set Preferred Event
Automated Vetting
Classification
Rapid Sky Localization
Preliminary Alert Sent
Parameter Estimation
Human Vetting
Classification
Initial Alert or Retraction Sent
Parameter Estimation
Classification
Update Alert Sent
10 second
1 minute
1 hour
1 day
1 week

Timeline

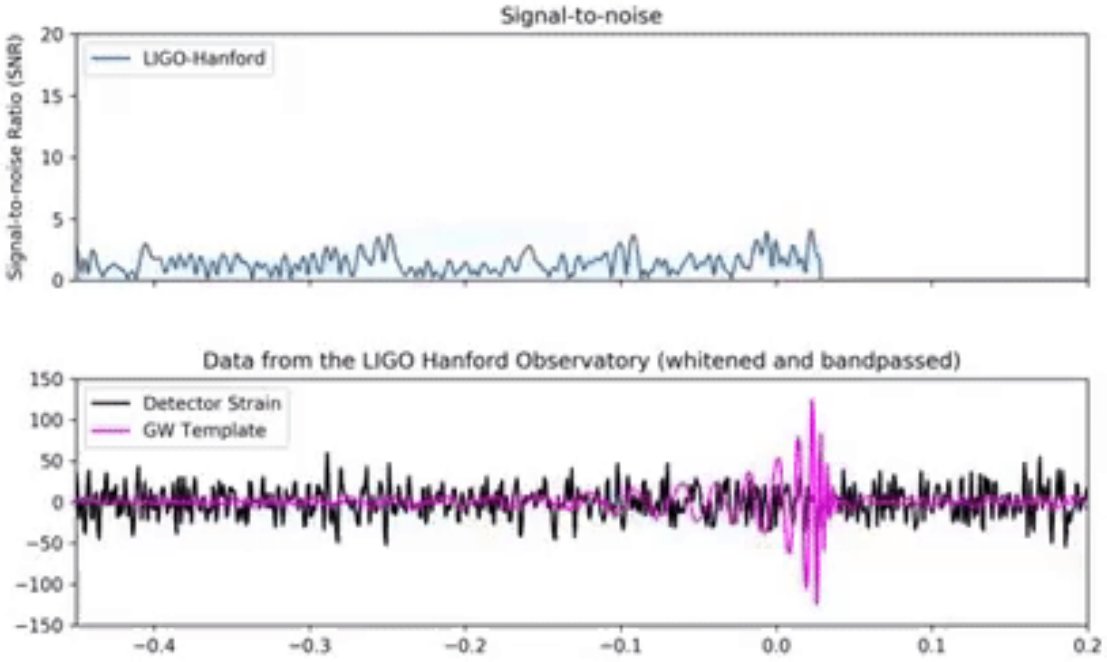


Several pipelines, each can make several detections

Based on a given criteria, one is chosen as being the **Prefered Event** (for the public alert)

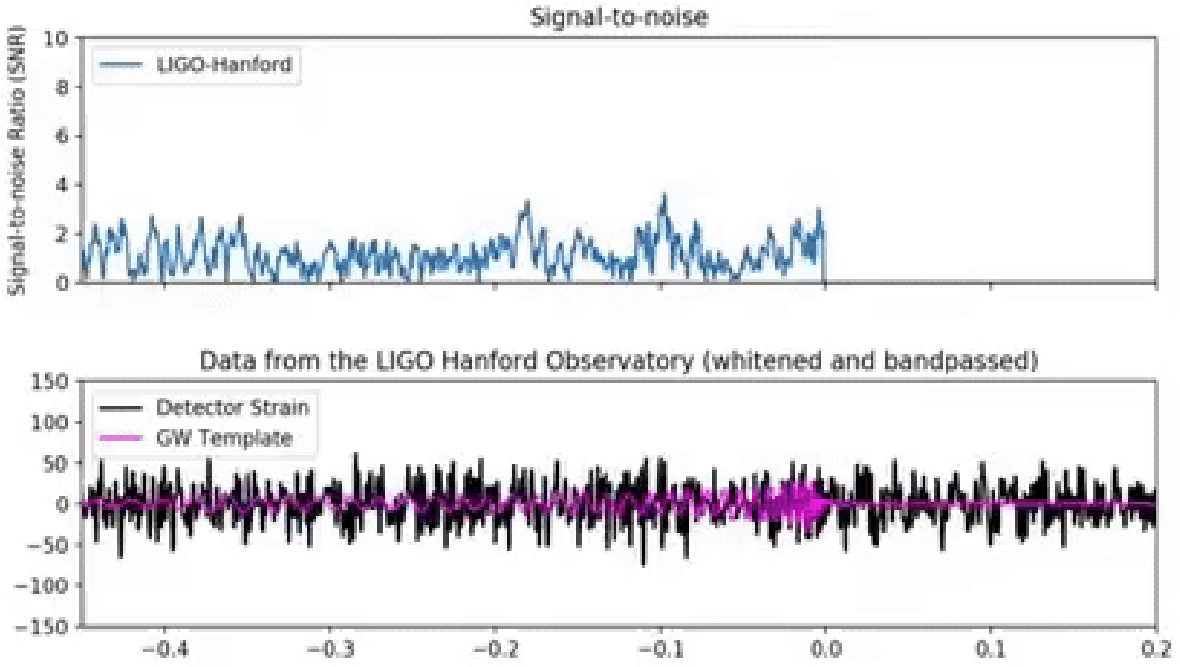
Modeled searches	Unmodeled searches
GSTLAL	cWB
MBTA	oLIB
PyCBC	
SPIIR	

Typical modeled search



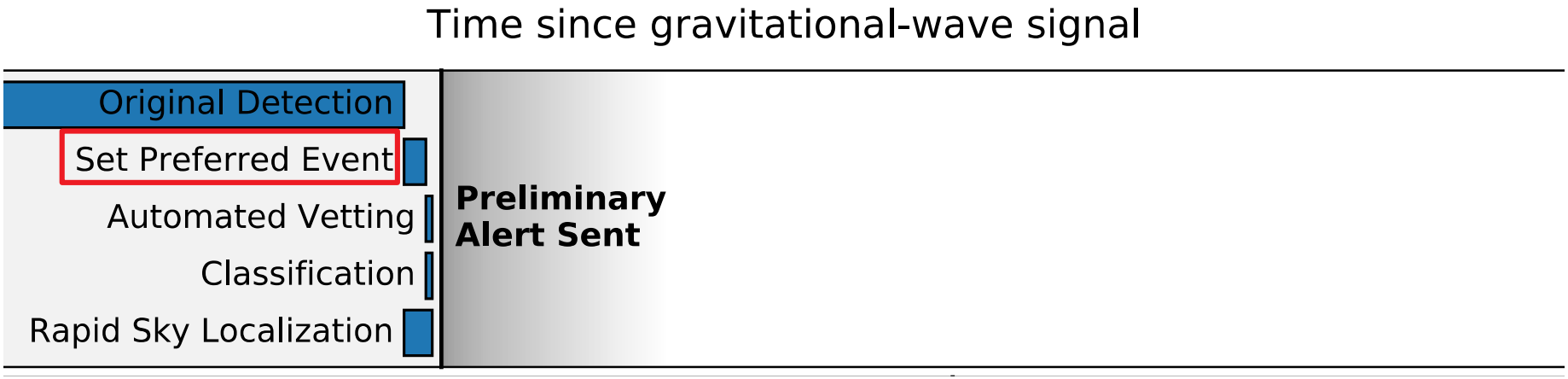
GW150914

Typical modeled search



GW151226

Timeline



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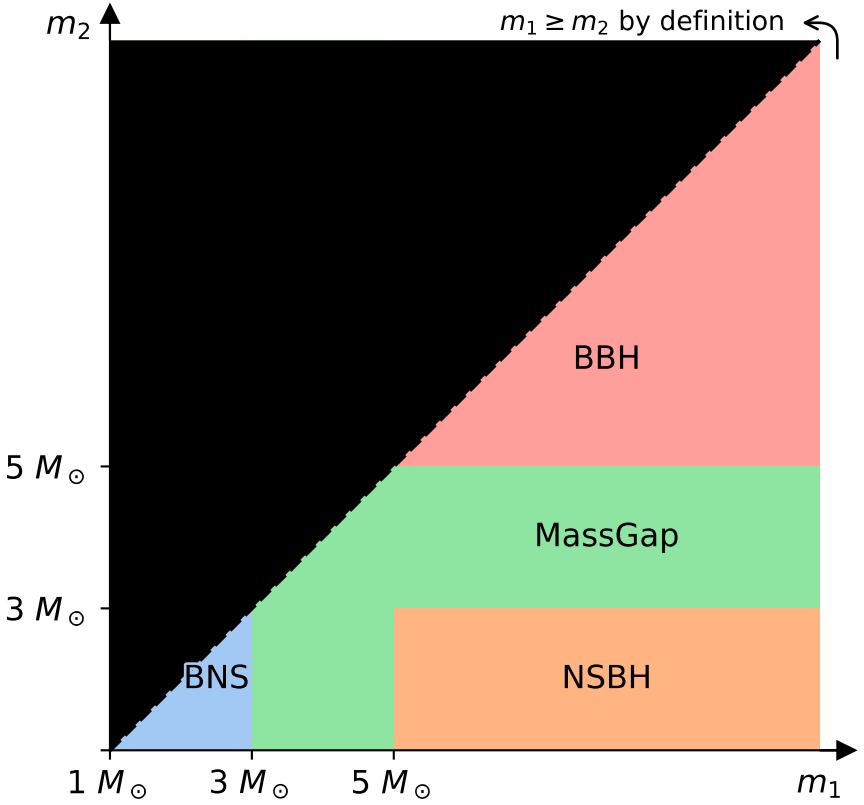
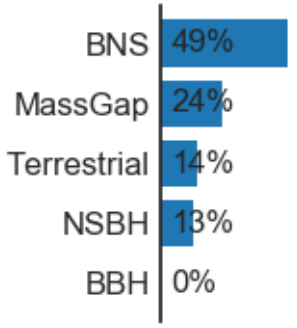
Timeline

Time since gravitational-wave signal

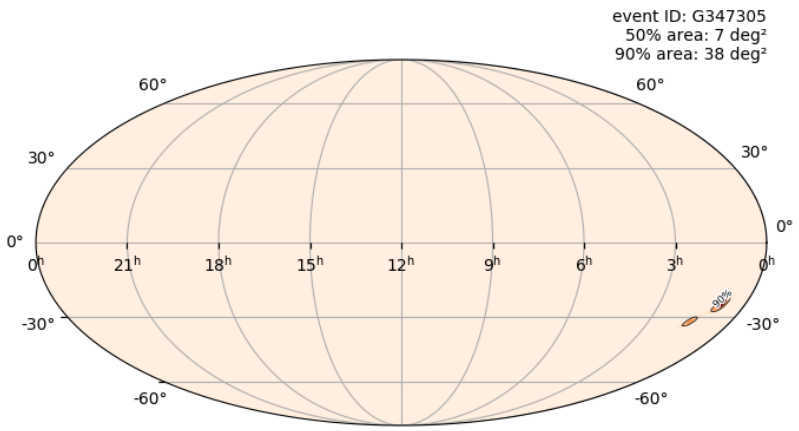


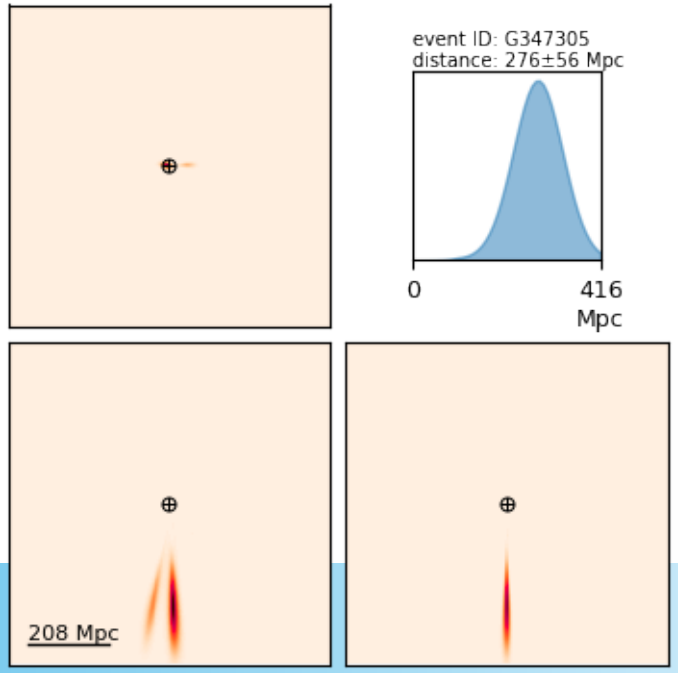
Example



Timeline

Time since gravitational-wave signal

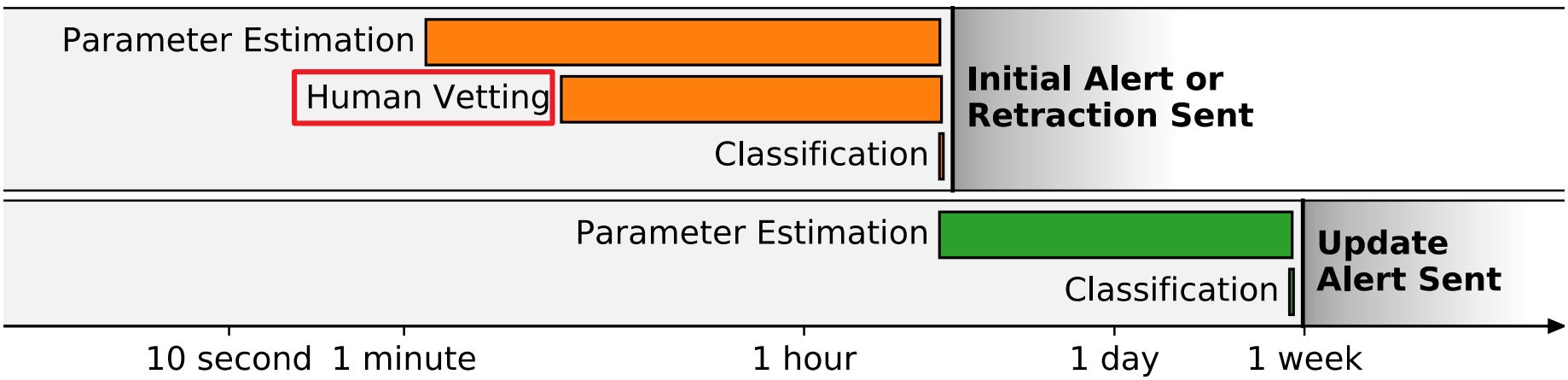




S190814bv (NSBH)

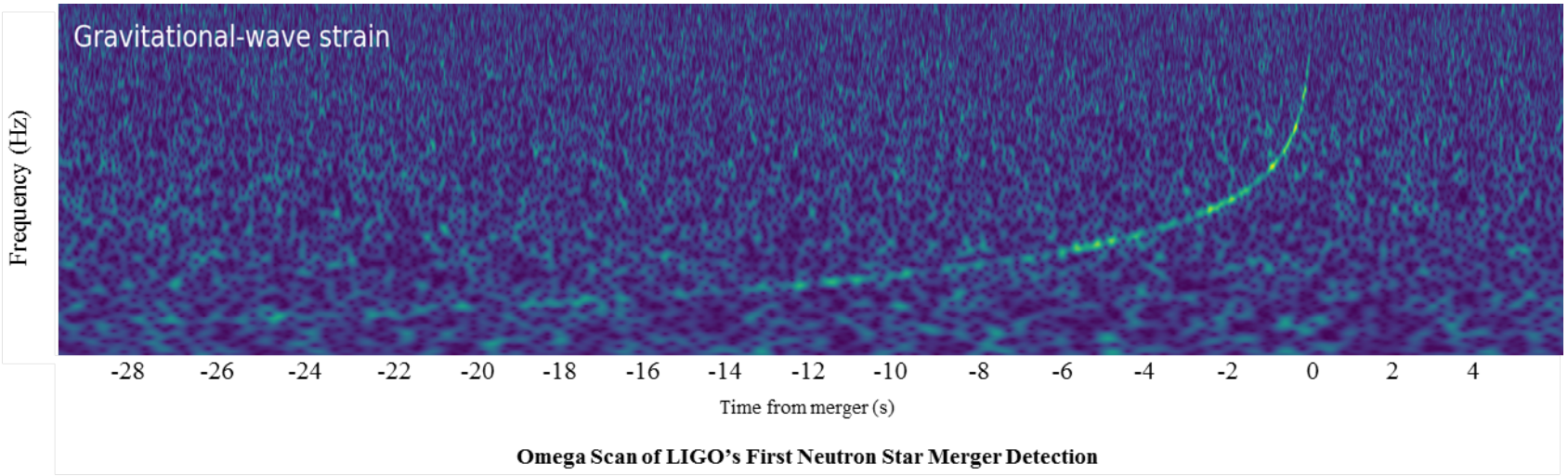
Timeline

Time since gravitational-wave signal



Human vetting versus glitches

Chirp for GW170817 (BNS)



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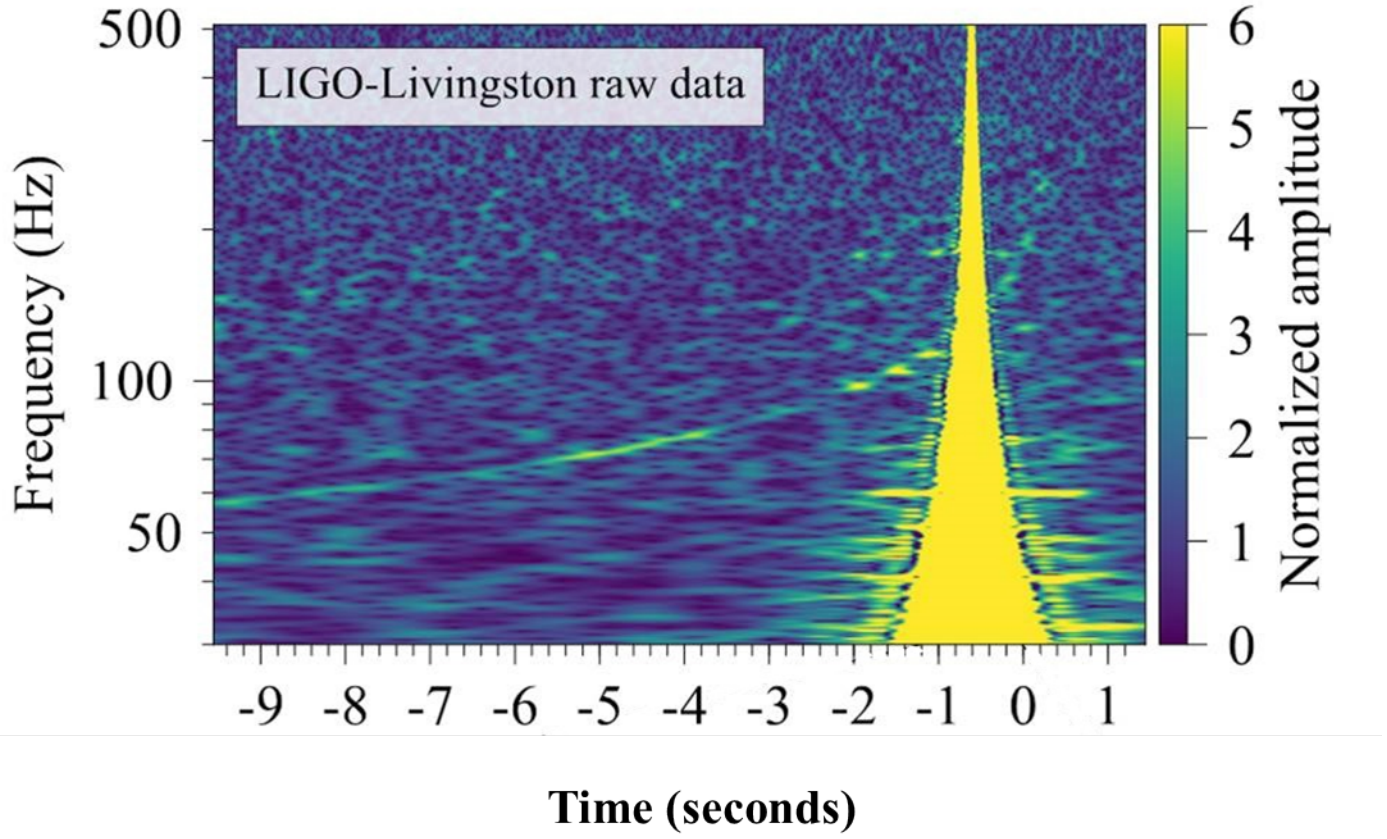
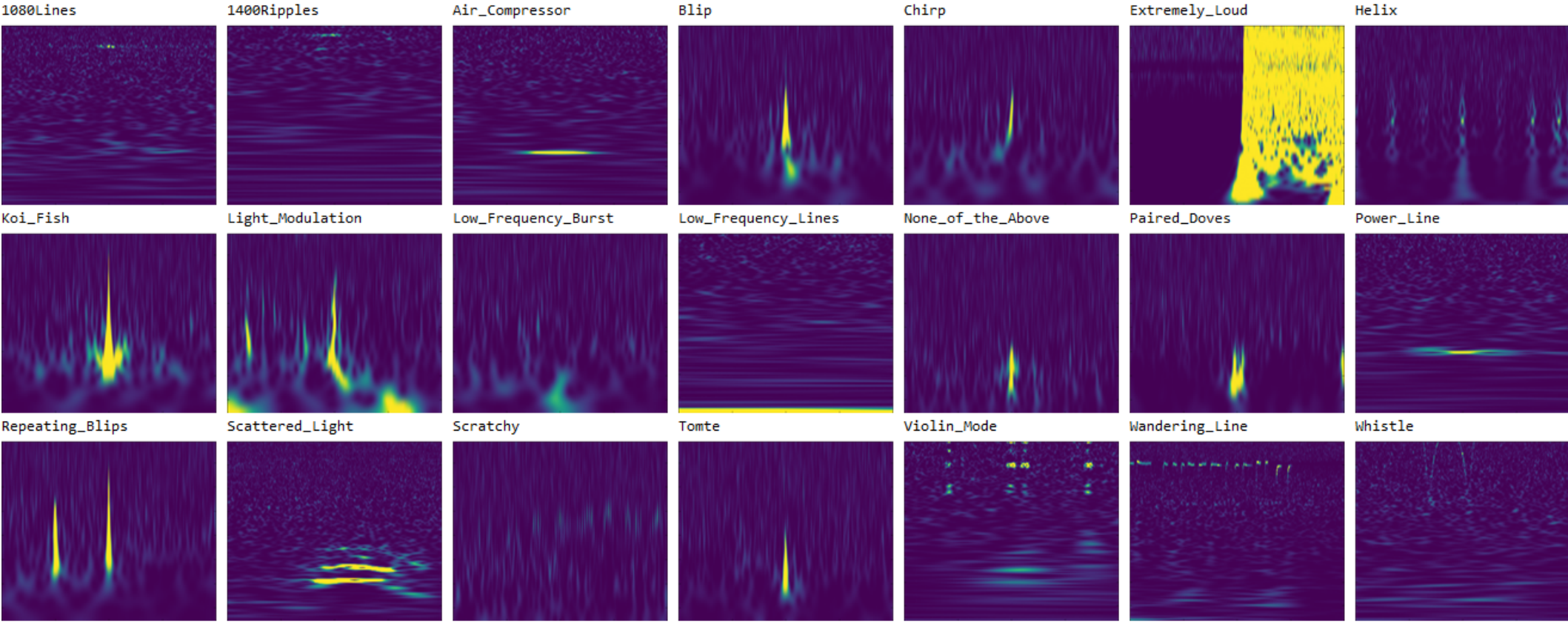


Human vetting versus glitches

Anyone can help characterizing glitches at Gravity Spy
(collaborative: provide training for IA)



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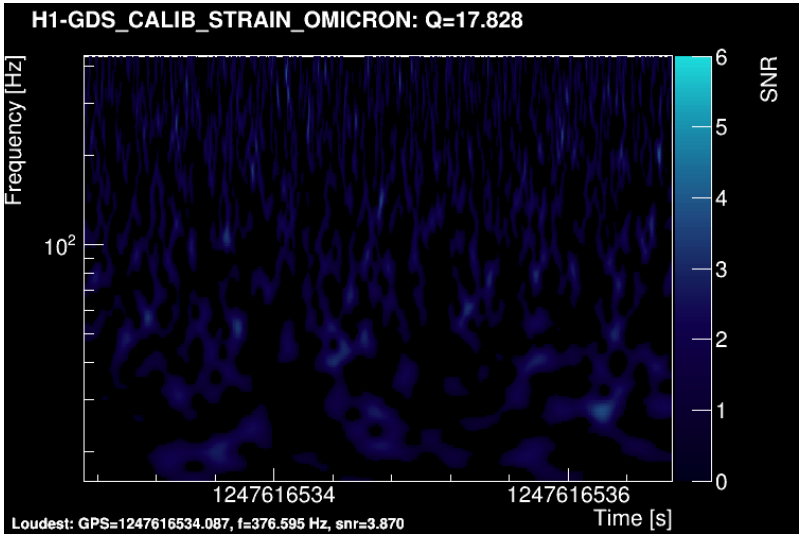

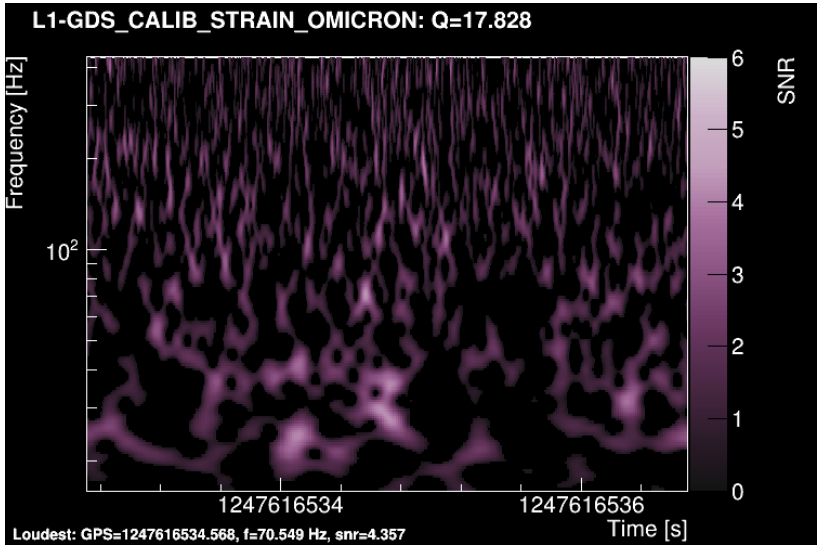

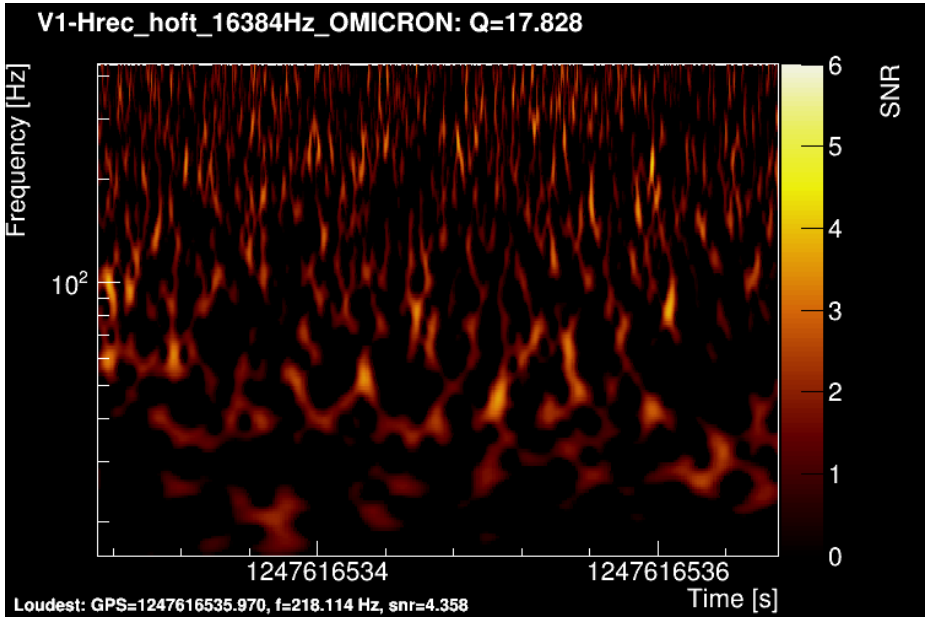

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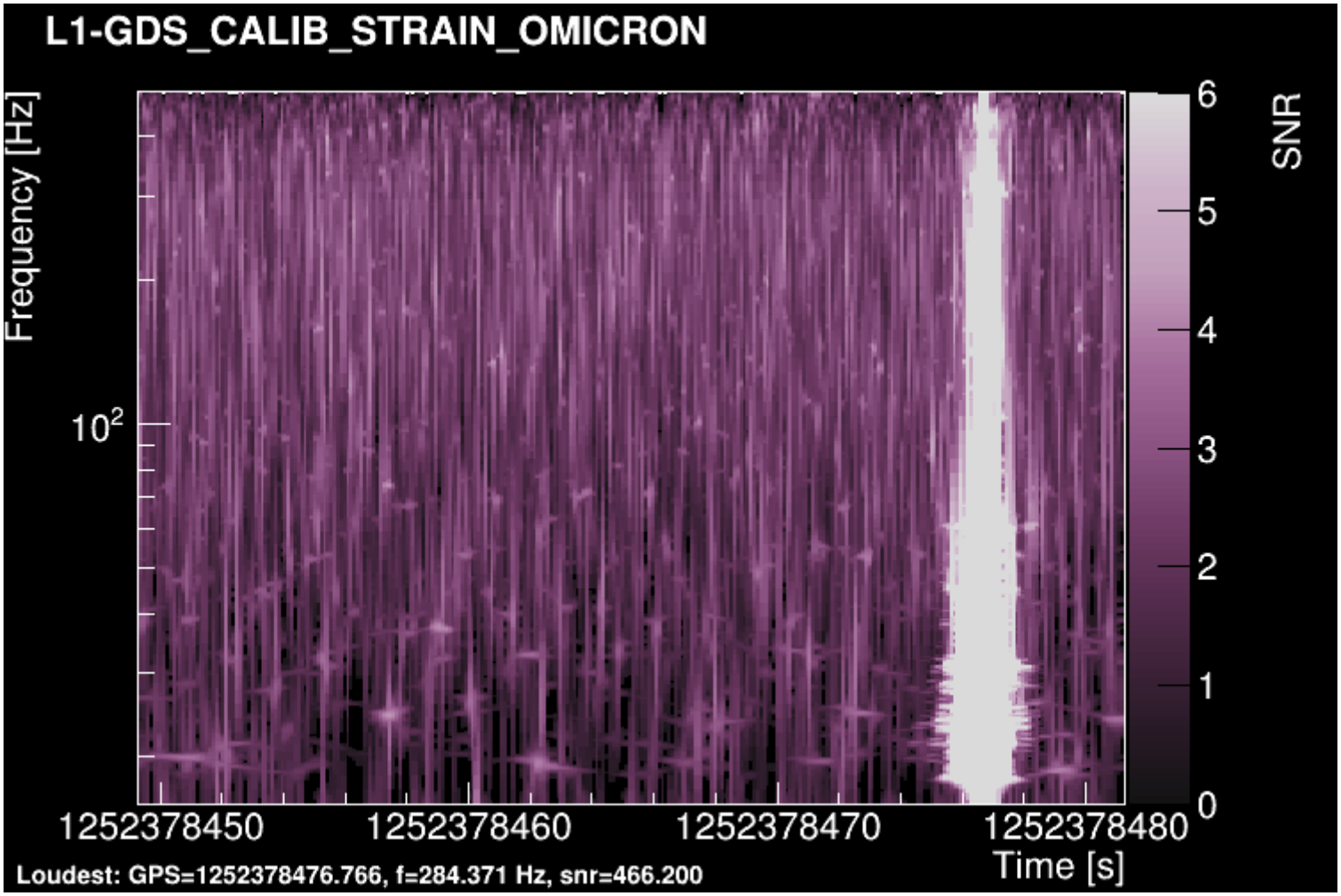
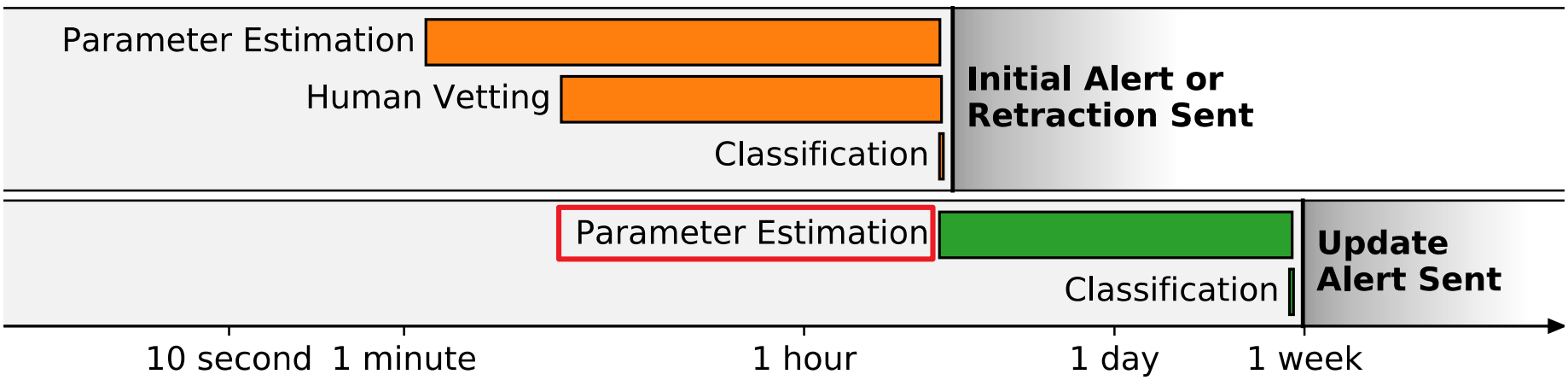


Timeline

Time since gravitational-wave signal



Parameter estimation: LALInference

Bayesian parameter estimation

Markov Chain Monte Carlo (MCMC) or Nested sampling

15 parameters:

- 2 masses
- Luminosity distance
- Right ascension & declination
- Inclination angle
- Polarization angle
- Reference time
- Orbital phase at reference time
- 2 spin magnitudes
- Two angles for each spin

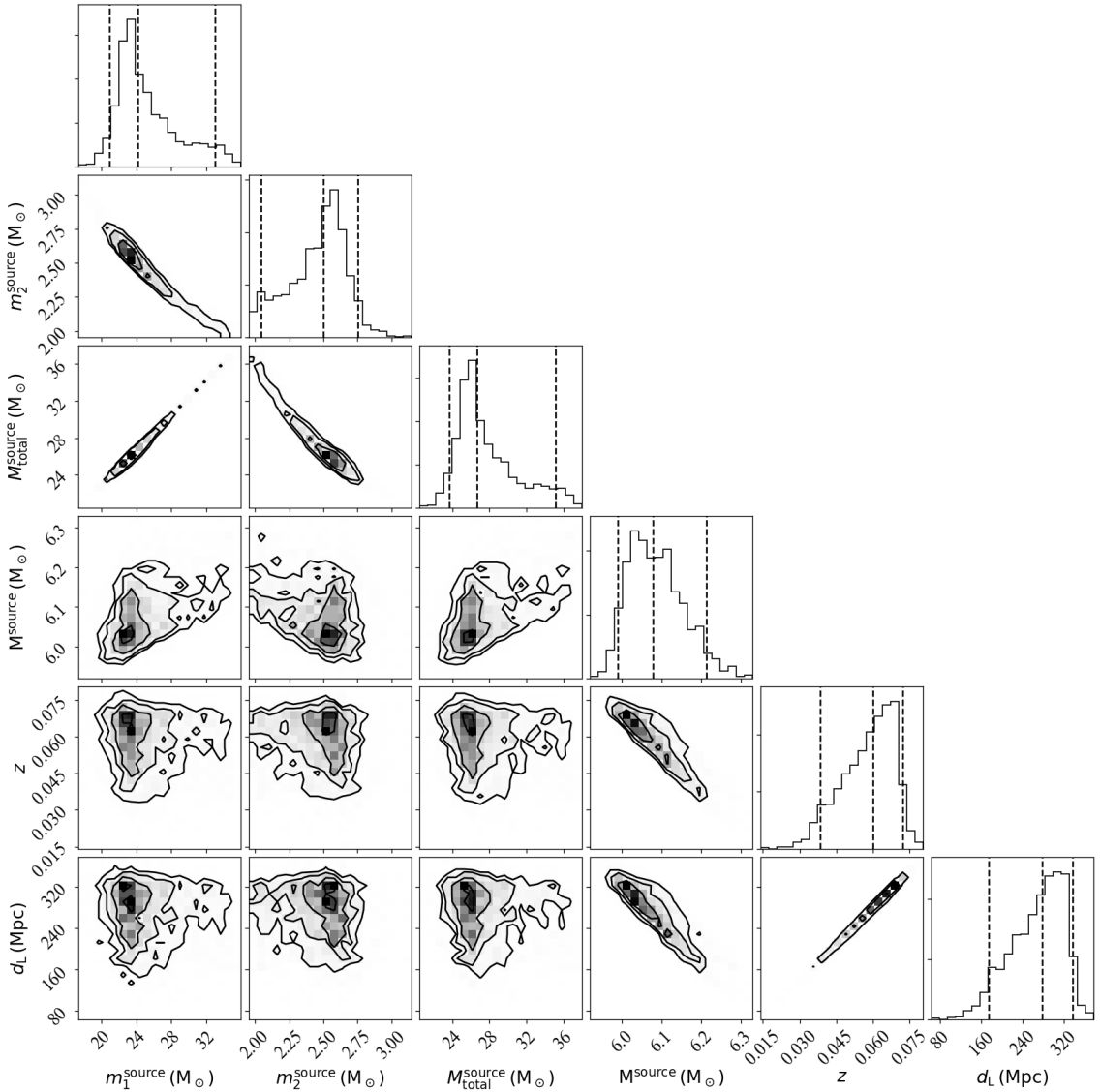
Several models (under permanent improvement):

- Frequency domain
  - Post-Newtonian waveform
  - Phenomenological calibrated to numerical relativity
- Time domain
  - Post-Newtonian waveform
  - Effective One Body (EOB) → inspiral-merger-ringdown

With several EOS models for BNS and NSBH

Veitch et al. (with Christensen!) PRD 91, 042003 (2015)

Parameter estimation: LALInference



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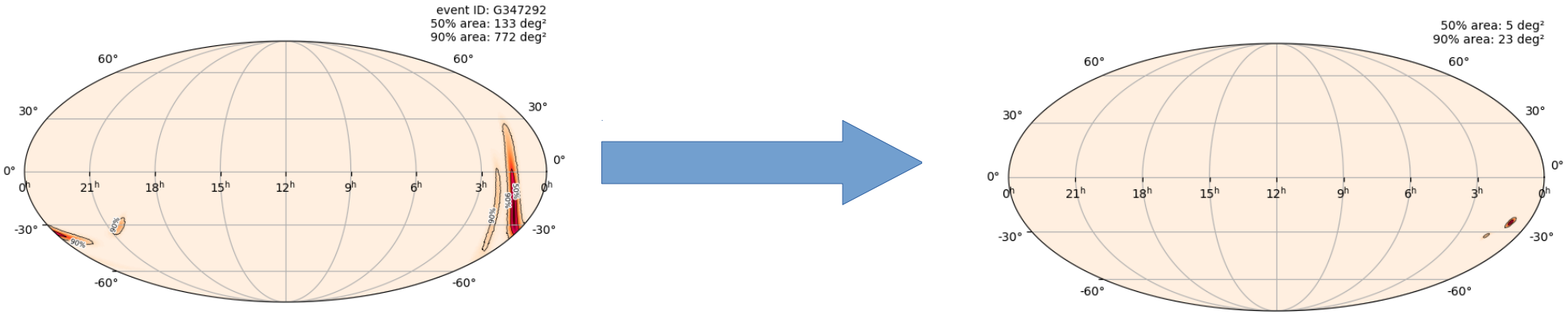
Improved skymaps

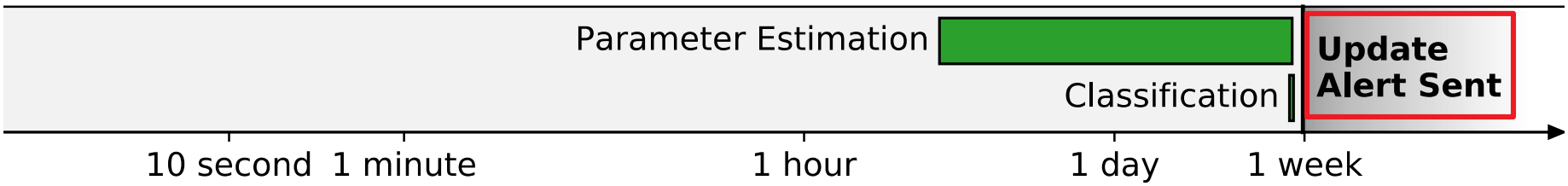
Sometimes significant improvement



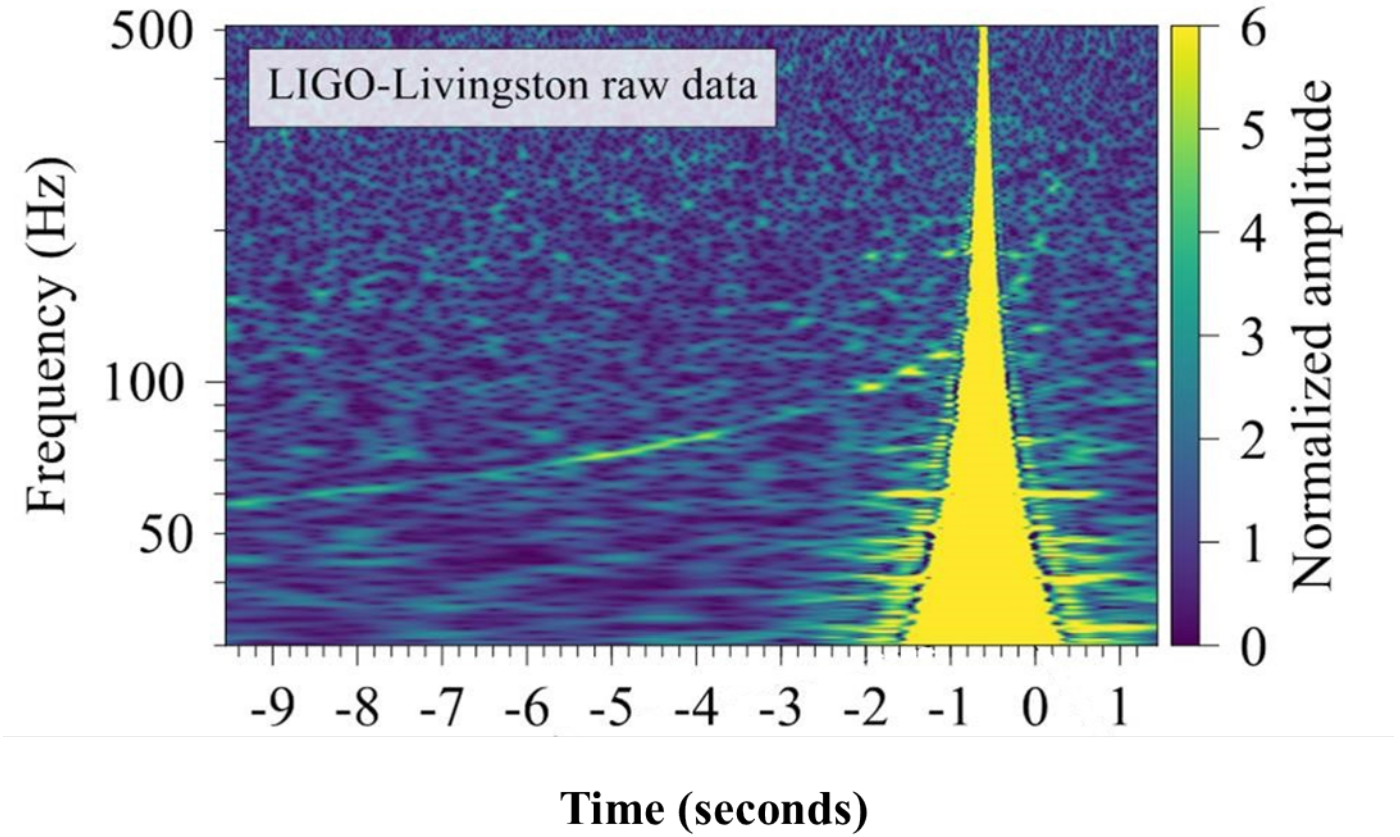
Timeline

Time since gravitational-wave signal

If better skymap and/or classification → update



Back to GW170817



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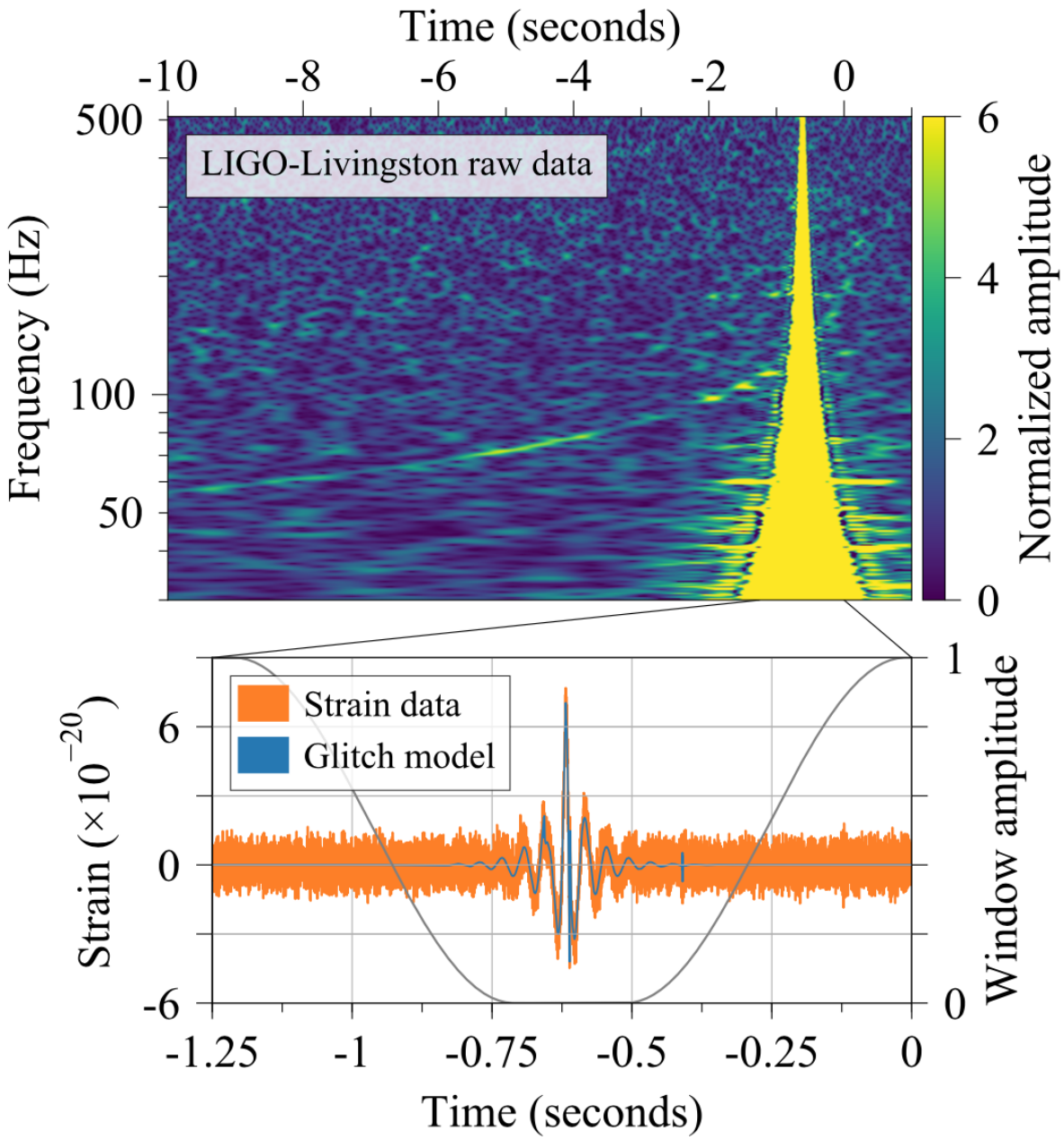

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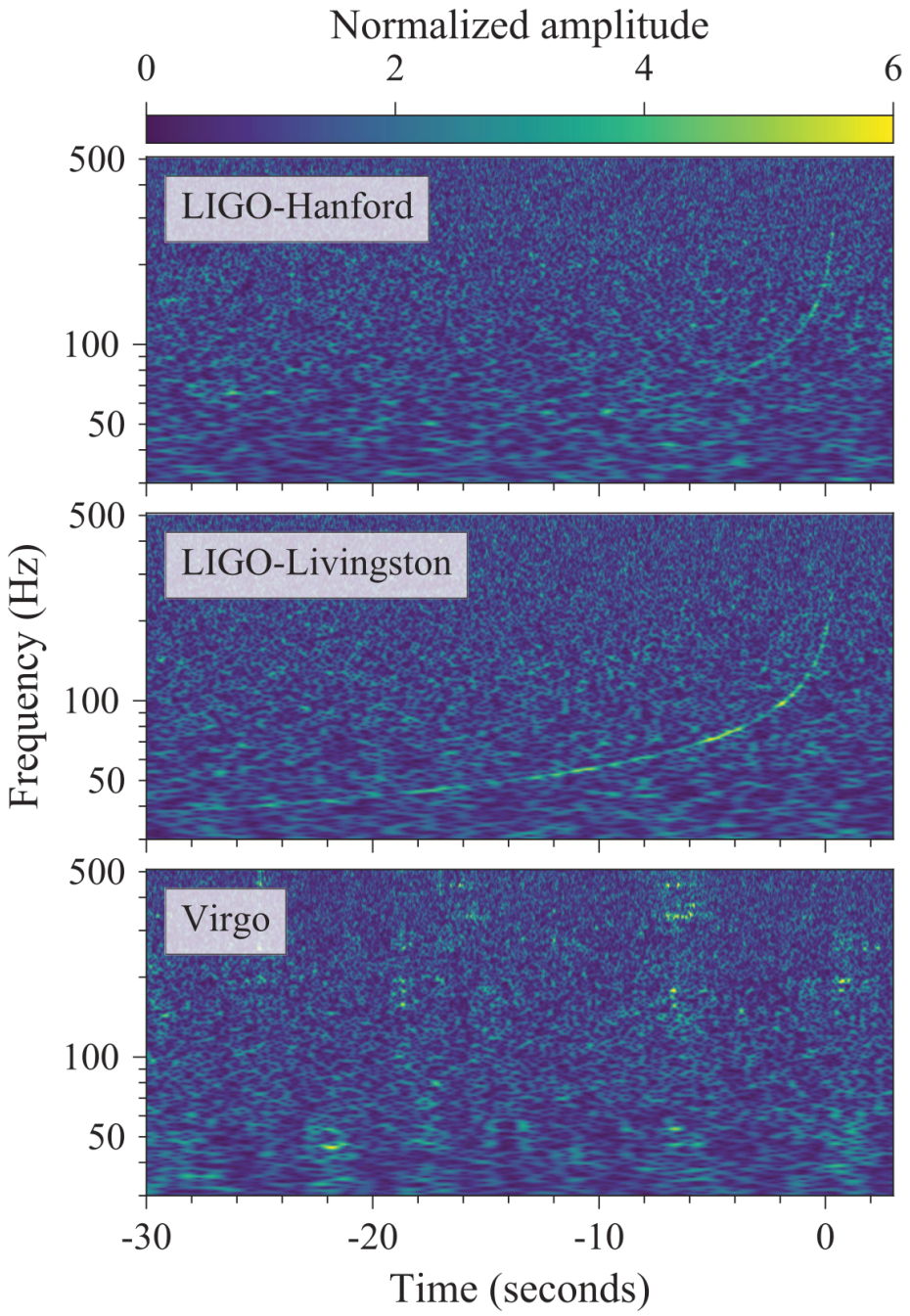
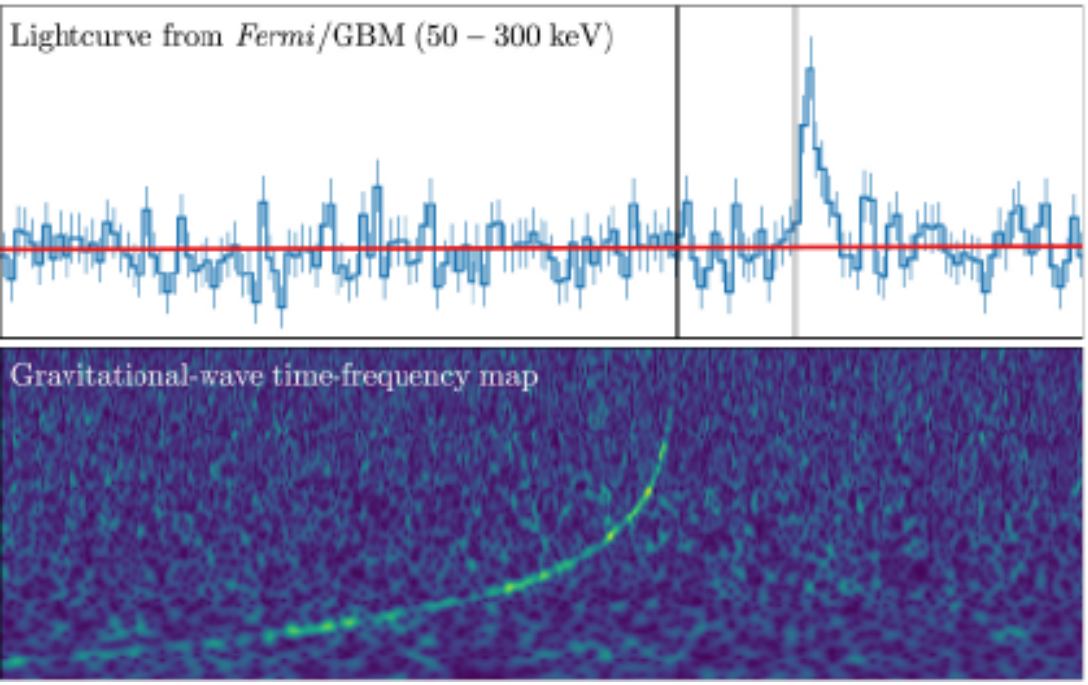
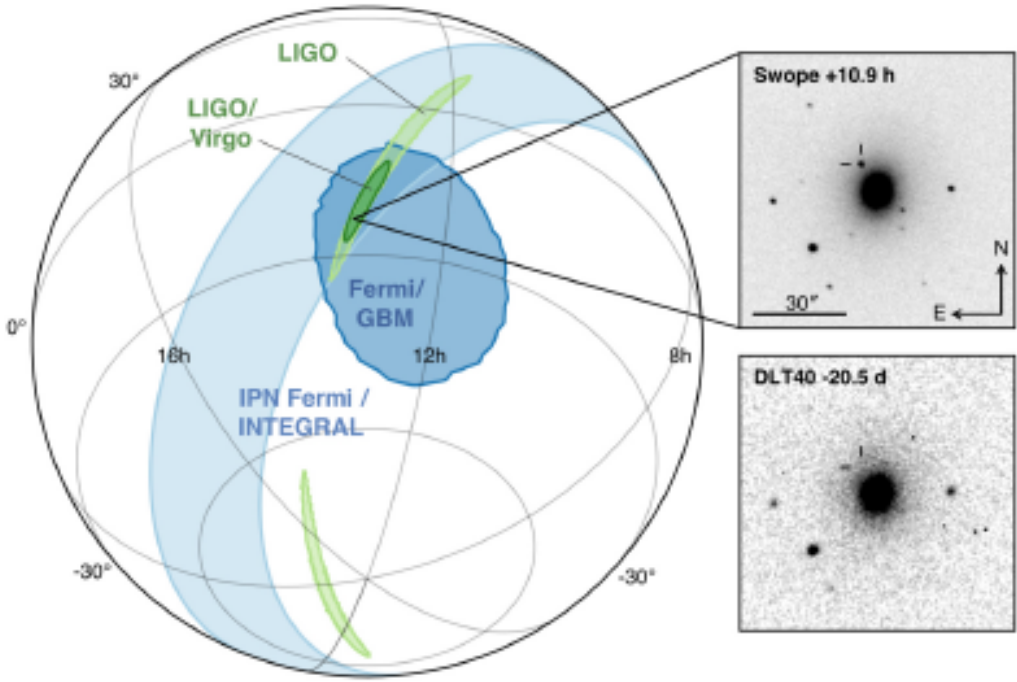


END





All public O3 events can be found on GraceDB: https://gracedb.ligo.org/superevents/public/O3/

Tutorials and software open source on GWOSC: https://www.gw-openscience.org/about/
(GWOSC: Gravitational Wave Open Science Center)

You can search for GWs signals in actual data from O1 and O2 with ~ one hour training!
(and learn in preparation for O3)

THANK YOU