
ER15/04 public alerts so far

— Francesco DiRenzo, Keita Kawabe, Hisaaki Shinkai

May/25/2023, Open LVKEM Townhall

O4 started and we already distributed public alerts!!



<https://gracedb.ligo.org/superevents/public/>

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Authenticated as: Kaito Kowabe






O4 Detection Candidates: 1 (1 Retraction)

SORT: EVENT ID (A-Z) ▾

Event ID	Possible Source (Probability)	UTC	GCN	Location	FAR	Comments
S230525a	BBH (72%), Terrestrial (28%)	May 25, 2023 02:38:17 UTC	GCN Circular Query Notices VOE		23.711 per year	
S230524x	BNS (75%), Terrestrial (25%)	May 24, 2023 20:22:41 UTC	GCN Circular Query Notices VOE		2.2799 per year	RETRACTED

ER15 Detection Candidates: 6 (0 Retractions)

SORT: EVENT ID (A-Z) ▾

Event ID	Possible Source (Probability)	UTC	GCN	Location	FAR	Comments
S230524b	BBH (73%), Terrestrial (27%)	May 24, 2023 06:13:20 UTC	GCN Circular Query Notices VOE		26.052 per year	
S230522n	BBH (99%)	May 22, 2023 15:30:33 UTC	GCN Circular Query Notices VOE		1 per 4.8908 years	
S230522a	BBH (>99%)	May 22, 2023 09:38:05 UTC	GCN Circular Query Notices VOE		1 per 3.0614 years	
S230521k	Terrestrial (60%), BNS (25%), NSBH (14%)	May 21, 2023 05:30:43 UTC	GCN Circular Query Notices VOE		76.393 per year	
S230520ae	BBH (>99%)	May 20, 2023 22:48:42 UTC	GCN Circular Query Notices VOE		1 per 10.354 years	
S230518h	NSBH (86%), Terrestrial (10%), BBH (4%)	May 18, 2023 12:59:08 UTC	GCN Circular Query Notices VOE		1 per 98.463 years	

March/30/2023 Open LVKEM Slides



New Threshold for alerts.

Updated Public Alert Threshold for O4*

The false alarm rate threshold for public alerts will be lowered to **2/day** starting in O4. There will therefore be two classes of alerts:

Low Significance (“Subthreshold” in O3) gravitational-wave alerts with false alarm rate greater than **1/month for CBC** and **1/year for Burst**

Significant gravitational-wave alerts with false alarm rate less than **1/month** and **1/year for Burst** that pass automated and manual verification

*May be tuned slightly during the engineering run.

- Significant and Low Significance public alerts.
- Early warning (pre-merger) alerts.

Alert summary for O4

Early warning (pre-merger) alerts will be provided

Multiple distribution channels for alerts:

GCN Notices and Circulars as in O3.

Kafka based alerts with embedded skymap via SCiMMA and GCN

Apr/27/2023 OpenLVKEM slides about ER15

ER15: What to expect

- GW analysis pipelines WILL start uploading real event candidates, which MAY result in public alerts.
 - Start date MAY differ for different pipelines (“subject to internal reviews”).
- RRT will NOT provide human response to public alerts in ER15 (except when REALLY interesting candidates are identified, e.g. next GW170817).
- But RRT WILL pick at least one BBH candidate and perform an end-to-end test of manual procedure, including the submission of GCN Initial Circular.
 - Will append “: End-to-End Test” to the usual subject, e.g. “SUBJECT: LIGO/Virgo/KAGRA S1234: Identification of a GW compact binary: **End-to-End Test**”.
 - This will be a legitimate Circular, but please understand that this is only done for testing RRT procedure.

No human response except for

- REALLY interesting
- BBH picked for End to End test of manual procedure



All of these things happened in ER15 + O4

O4 Detection Candidates: 1 (1 Retraction)

<https://gracedb.ligo.org/superevents/public/>

SORT: EVENT ID (A-Z) ▾

O4

Event ID	Possible Source (Probability)	UTC	GCN	Location	FAR	Comments
S230525a	BBH (72%), Terrestrial (28%)	May 24, 2023 02:35:17 UTC	GCN Circular Query Notices VDE		23.711 per year	Low Significance (= no human response)
S230524x	BNS (75%), Terrestrial (25%)	May 24, 2023 02:22:11 UTC	GCN Circular Query Notices VDE		2.2799 per year	Early Warning (Retracted)

ER15 Detection Candidates: 6 (0 Retractions)

SORT: EVENT ID (A-Z) ▾

ER15

Event ID	Possible Source (Probability)	UTC	GCN	Location	FAR	Comments
S230524b	BBH (73%), Terrestrial (27%)	May 24, 2023 06:13:20 UTC	GCN Circular Query Notices VDE		26.052 per year	Low Significance (= no human response)
S230522n	BBH (99%)	May 22, 2023 02:50:53 UTC	GCN Circular Query Notices VDE		1 per 4.8908 years	No human response
S230522a	BBH (>99%)	May 22, 2023 08:38:05 UTC	GCN Circular Query Notices VDE		1 per 3.0614 years	No human response
S230521k	Terrestrial (60%), BNS (25%), NSBH (14%)	May 21, 2023 05:30:43 UTC	GCN Circular Query Notices VDE		76.393 per year	Low Significance (= no human response)
S230520ae	BBH (>99%)	May 20, 2023 22:48:42 UTC	GCN Circular Query Notices VDE		1 per 10.354 years	RRT E2E Test
S230518h	NSBH (86%), Terrestrial (10%), BBH (4%)	May 18, 2023 12:59:08 UTC	GCN Circular Query Notices VDE		1 per 98.463 years	Really interesting

S230518h (likely NSBH) : 2 circulars from LVK; 18 follow-up obs so far.

GCN Circular 33813

Subject LIGO/Virgo/KAGRA S230518h: Identification of a GW compact binary merger candidate
Date 2023-05-18T14:06:25Z (7 days ago)
From f.di-renzo@ip2i.in2p3.fr

The LIGO Scientific Collaboration, the Virgo Collaboration, and the KAGRA Collaboration report:

We identified the compact binary merger candidate S230518h during real-time processing of data from LIGO Hanford Observatory (H1) and LIGO Livingston Observatory (L1) at 2023-05-18 12:59:08.167 UTC (GPS time: 1368449966.167). The candidate was found by the PyCBC Live [1], GstLAL [2], and MBTAOnline [5] analysis pipelines.

The LIGO detectors are currently operating in an "engineering run" mode prior to the start of the O4 observing run. The data being collected at the time of this candidate is believed to be of good quality based on preliminary checks, but requires further investigation. A decision was made to alert the community promptly, with this caveat, due to the potential significance of this candidate.

S230518h is an event of interest because its false alarm rate, as estimated by the online analysis, is $3.2e-10$ Hz, or about one in 98 years. The event's properties can be found at this URL:
<https://gracedb.ligo.org/superevents/S230518h>

The classification of the GW signal, in order of descending probability, is NSBH (86%), Terrestrial (10%), BBH (4%), or BNS (<1%).

Assuming the candidate is astrophysical in origin, the probability that the lighter compact object is consistent with a neutron star mass (HasNS) is >99%. [3] Using the masses and spins inferred from the signal, the probability of matter outside the final compact object (HasRemnant) is < 1%. Both HasNS and HasRemnant consider the support of several neutron star equations of state. The probability that any one of the binary components lie between 3 to 5 solar mass (HasMassgap) is < 1%.

One sky map is available at this time and can be retrieved from the GraceDB event page:

* bayestar.mtorder.fits, an initial localization generated by BAYESTAR [4], distributed via GCN Notice about 39 minutes after the candidate event time.

For the bayestar.mtorder.fits sky map, the 90% credible region is 1002 deg². Marginalized over the whole sky, the a posteriori luminosity distance estimate is 276 +/- 79 Mpc (a posteriori mean +/- standard deviation).

For further information about analysis methodology and the contents of this alert, refer to the LIGO/Virgo/KAGRA Public Alerts User Guide <<https://emfollow.docs.ligo.org/userguide/>>.

- [1] Dal Canton et al. ApJ 923, 254 (2021)
- [2] Tsukada et al. arXiv:2305.06286 (2023) and Ewing et al. arXiv:2305.05625 (2023)
- [3] Chatterjee et al. The Astrophysical Journal 896, 1 (2020)
- [4] Singer & Price PRD 93, 024013 (2016)
- [5] Aubin et al. CQG 38, 095004 (2021)

<https://gcn.nasa.gov/circulars/33813>

GCN Circulars

GCN Circulars are rapid astronomical bulletins submitted by and distributed to community members worldwide. Discoveries, observations, quantitative near-term predictions, requests for follow-up observations, or future observations of energy, multi-messenger, and variable or transient astrophysical events. See the [documentation](#) for help with using GCN Circulars.

20 results found.

- 33872. [LIGO/Virgo/KAGRA S230518h: No transient candidates in CALET observations](#)
- 33851. [LIGO/Virgo/KAGRA S230518h: Swift/UVOT Upper Limits for MeerLICHT candidates: AT2023ixg and AT2023j](#)
- 33843. [IPN triangulation of GRB 230518A \(short\)](#)
- 33834. [LIGO/Virgo/KAGRA S230518h: ATCA follow-up of candidate counterparts](#)
- 33833. [LIGO/Virgo/KAGRA S230518h: GECKO tiling observations with KMTNet](#)
- 33832. [LIGO/Virgo/KAGRA S230518h: Swift/UVOT Upper Limits for Swope candidates: SSS23a, SSS23b and SSS23c](#)
- 33830. [LIGO/Virgo/KAGRA S230518h: ATLAS observations of the skymap](#)
- 33829. [LIGO/Virgo/KAGRA S230518h: Swope Search and Candidate Counterpart Identification](#)
- 33827. [LIGO/Virgo/KAGRA S230518h: Upper limits from Konus-Wind observations](#)
- 33826. [LIGO/Virgo S230518h: AGILE/MCAL observations](#)
- 33824. [LIGO/Virgo S230518h: Swift XRT observations, 8 X-ray sources](#)
- 33823. [LIGO/Virgo/KAGRA S230518h: Coverage and upper limits from MAXI/GSC observations](#)
- 33820. [LIGO/Virgo/KAGRA S230518h: NED Galaxies in the Localization Volume](#)
- 33819. [LIGO/Virgo/KAGRA S230518h: AstroSat CZTI non-detection and upper limits](#)
- 33818. [LIGO/Virgo/KAGRA S230518h: Upper limits from Fermi-GBM Observations](#)
- 33817. [LIGO/Virgo S230518h: Global MASTER-Net observations report](#)
- 33816. [LIGO/Virgo/KAGRA S230518h: Updated Sky localization and EM Bright Classification](#)
- 33815. [LIGO/Virgo S230518h: No counterpart candidates in INTEGRAL SPI-ACS prompt observation](#)
- 33814. [LIGO/Virgo S230518h: Upper limits from IceCube neutrino search](#)
- 33813. [LIGO/Virgo/KAGRA S230518h: Identification of a GW compact binary merger candidate](#)

5 Significant (1 retracted), 3 Low Significance so far.

RRT provided human response to 3 Significant candidates (one NSBH, one BBH for E2E test and one Early Warning which was retracted).

RRT procedure seems to have worked well.

Some didn't receive GCN Early Warning Notice, only Retraction. This is under investigation.

There were other minor issues but those are not critical. Some were already addressed, some will be addressed in the near future.

All in all, this is a good start. I expect that minor hiccups will be found and dealt with as we go for a few weeks.