EM Follow-up Advocates:

a short guide

https://ldas-jobs.ligo.caltech.edu/~emfollow/followup-advocate-guide/introduction.html

Barbara Patricelli[1,2]

[1] Università di Pisa
[2] INFN - Sezione di Pisa

Virgo-Pisa meeting

June 6, 2019

Outline

Public GW alerts

Public LIGO/Virgo alerts are distributed using NASA's Gamma-ray Coordinates Network (GCN). There are two types of alerts:

- **GCN Notices** are machine-readable packets. They are available as VOEvent XML and several other formats.

```
Packet Type = LVC_PRELIMINARY

PKT INFO: PKT 150   Received: LT Sun Jun  2 18:06:00 2019
  TYPE= 150     SN  = 106
  Hop_cnt= 0
  here sod= 65160   PKT_SOD=  65158.00 [sec]   delta=     2.00
  ID_NUMBER= S190602aq
  ALERT_TJD= 18636
  ALERT_SOD= 64767.089355     delta=    393.00
========== GW ALERT PRELIMINARY ==========
  GW ALERT at 2019/06/02 17 h 59 m 27 s
  GW ALERT: Evt type = 0x0001010f
     group     1 = CBC
     search    1 = AllSky
     pipeline  15 = pycbc
     FAR = 1.9006e-09 [Hz]
     Terrestrial (noise) Probability = 0.00
     BBH Probability              = 0.99
     NSBH Probability             = 0.00
     BNS Probability              = 0.00
     Mass Gap Probability         = 0.00
     Remnant Probability          = 0.00
     Neutron Star Probability     = 0.00
==========================================

==========Solution found for this trigger=======================
  This is a REAL event
  This is NOT an hardware injection event
  This event has NOT been vetted by a human
  This event is an open alert
  Source was not in temporal coincidence with another event
  LIGO-Hanford contributed to the event
  LIGO-Livingston contributed to the event
  Virgo contributed to the event
  This is a ground-generated notice
================================================================
  Skymap URL:     https://gracedb.ligo.org/apiweb/superevents/S190602aq/files/bayestar.fits.gz
  Event URL:      https://gracedb.ligo.org/superevents/S190602aq/view/
```

- **GCN Circulars** are short human-readable astronomical bulletins. They are written in a certain well-established format and style.

Notice/Circular types

- A **Preliminary GCN Notice** is issued automatically **within minutes** after a gravitational-wave candidate is detected. There is no accompanying GCN Circular at this stage.
- An **Initial GCN Notice and Circular** are issued after human vetting, **within 24 hours** from the GW trigger time (possibly **within 4 hours** in case of BNS or NS-BH). If the signal does not pass human vetting (i.e., it is a glitch), then instead of an initial alert there will be a **Retraction**.
- An **Update GCN Notice and Circular** are issued whenever further analysis leads to improved estimates of the source localization, significance, or classification.

EM follow-up advocates have a key role in the vetting procedure and in sending GCN Notice/Circulars to the astronomical community.

EM follow-up advocate duties: time scales

- EM follow-up advocate shifts are a week-long (from Friday to Friday) and they are performed by a team of 3-4 people
- **Within minutes** of a GW event, follow-up advocates should follow a prescribed procedure to review the event. Under certain conditions, call the Rapid Response Team (RRT) for immediate consultation.
- **Within hours**, they should join the call with the RRT to report on candidates in GraceDB and actions taken since the previous meeting of the team. RRT telecons are typically organized within 2 hours after a BNS/NS-BH candidate and once per day for BBH candidates.
- **Within days**, they should follow internal discussions of the LIGO/Virgo analysis of the event as well as follow-up observations by partners.

On-call procedure - Supervents

- **gwcelery** is the software which evaluates each new trigger entered into GraceDB. For triggers with low-enough false alarm rate, a **superevent** is created.
- A **superevent** consists of one or more event candidates, possibly from different pipelines, that are neighbors in time. At any given time, one event belonging to the superevent is identified as the preferred event. Each superevent is intended to represent a single astrophysical event.

PUBLIC SUPEREVENT

Superevent Info

Superevent ID	Category	Labels	Preferred event	GW events	External events	t_start	t_0	t_end	UTC Submission time	Li
S190602aq	Production	ADVOK SKYMAP_READY EMBRIGHT_READY PASTRO_READY DQOK GCN_PRELIM_SENT	G334993	G334992 G334993 G334994 G334995 G334996 G334997 G334998 G334999 G335000 G335001 G335002 G335003 G335004 G335005 G335006 G335007 G335008 G335009 G335010 G335011 G335012 G335013 G335014 G335015		1243533584.081266	1243533585.089355	1243533586.346191	2019-06-02 17:59:51 UTC	Da

Preferred Event Info

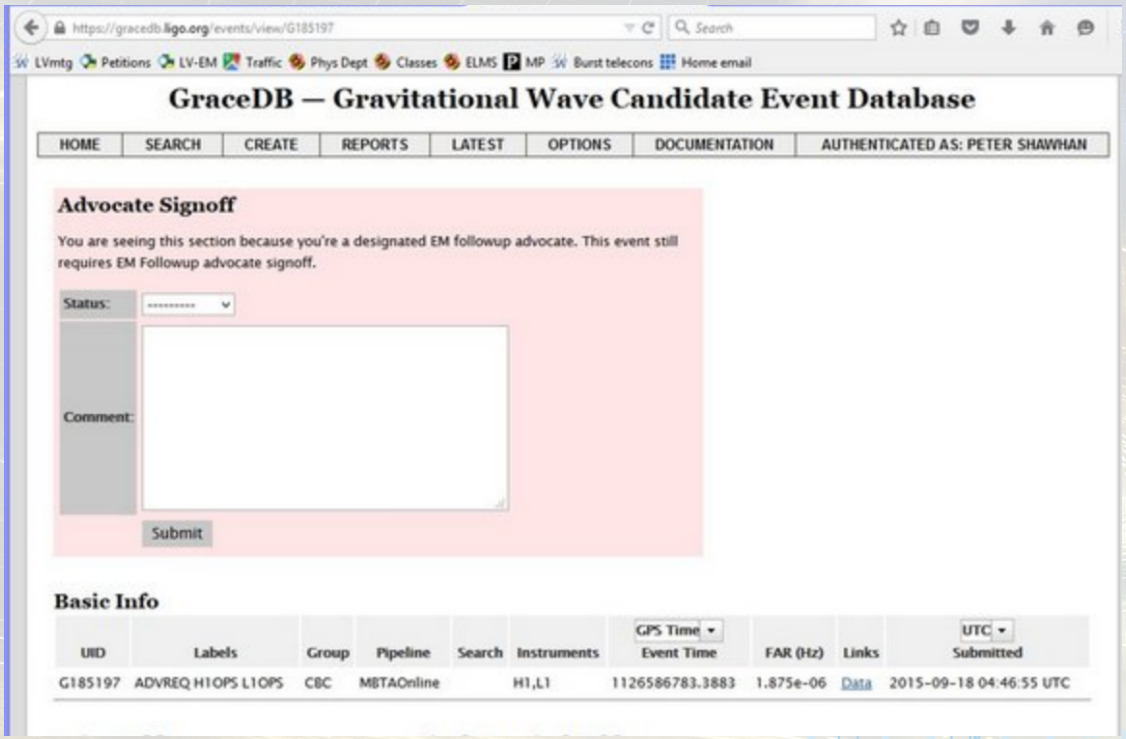
UID	Labels	Group	Pipeline	Search	Instruments	Event Time	FAR (Hz)	FAR (yr^{-1})	Links	Submitted
G334993	EMBRIGHT_READY PASTRO_READY SKYMAP_READY	CBC	pycbc	AllSky	H1,L1,V1	1243533585.09	1.901e-09	1 per 16.673 years	Data	2019-06-02 18:00:04 UTC

- For superevents with sufficiently low false alarm rate that also pass the low-latency data quality checks, a **PRELIMINARY GCN** notice is automatically issued and the ADVREQ label is applied to the superevent:

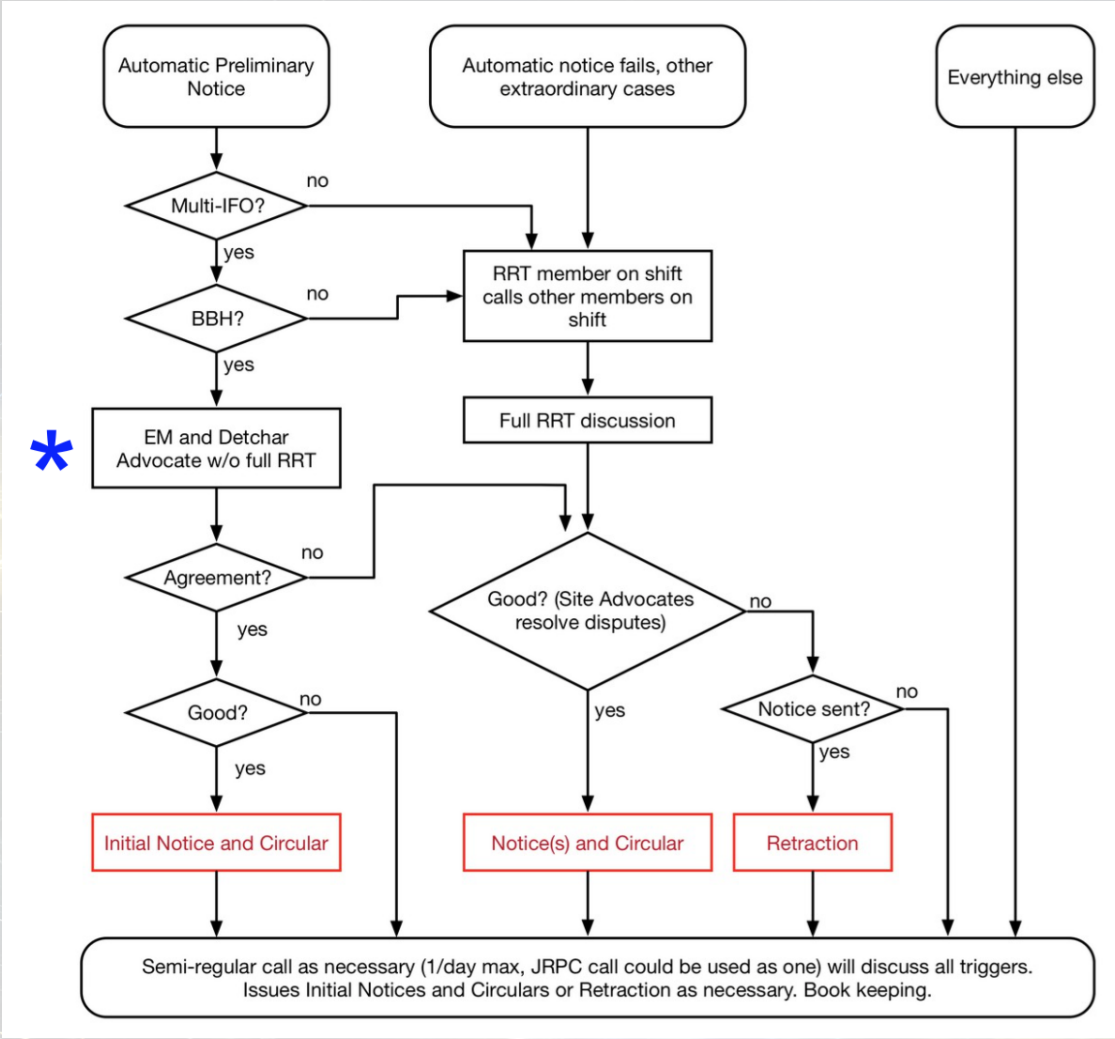
$\Rightarrow$ **the EM follow-up advocate work starts!**

On-call procedure: to do list

- The application of the ADVREQ label triggers the email message or phone call to the follow-up advocate.
- As soon as the ADVREQ notification is received, advocate should immediately connect to the EMfollow channel on TeamSpeak.
- Advocate should consult with DetChar experts, pipeline experts, and Run Coordinators on the TeamSpeak session to decide about the trigger
- Advocate should sign off on an event candidate - either OKAY or NOT OKAY



Rapid response flowchart



* Vetting procedure for Advocates w/o full RRT:
`https://ldas-jobs.ligo.caltech.edu/~emfollow/followup-advocate-guide/vetting.html`

Preparing and sending the GCNs

- Sign up to send and receive GCN Circulars:

  `https://gcn.gsfc.nasa.gov/gcn_circ_signup.html`

  Contact person: Scott Barthelmy

- Instruction for posting GCN Circulars:

  `https://gcn.gsfc.nasa.gov/gcn3_circulars.html`

- To write GCNs:
  - Guideline:

    `https://ldas-jobs.ligo.caltech.edu/~emfollow/followup-advocate-guide/circulars.html#guidelines-for-writing-circulars`

  - LIGO/Virgo GCN tool:

    `https://git.ligo.org/emfollow/ligo-followup-advocate/`

  - A GCN draft is automatically uploaded on gracedb

Writing GCN Circulars

UTC

Log Entry Created	Submitter	Comment
May 11, 2019 20:19:04 UTC	LIGO/Virgo EM Follow-Up	Template for update GCN Circular update-circular.txt
May 11, 2019 20:18:44 UTC	LIGO/Virgo EM Follow-Up	New VOEvent S190510g-5-Update.xml
May 11, 2019 20:18:43 UTC	LIGO/Virgo EM Follow-Up	User deep.chatterjee@LIGO.ORG queued a Preliminary alert through the dashboard.
May 10, 2019 20:44:11 UTC	LIGO/Virgo EM Follow-Up	Template for update GCN Circular update-circular.txt
May 10, 2019 20:43:51 UTC	LIGO/Virgo EM Follow-Up	New VOEvent S190510g-4-Update.xml
May 10, 2019 20:43:49 UTC	LIGO/Virgo EM Follow-Up	User shasvath.kapadia@LIGO.ORG queued a Preliminary alert through the dashboard.
May 10, 2019 10:23:15 UTC	LIGO/Virgo EM Follow-Up	Template for update GCN Circular update-circular.txt
May 10, 2019 10:22:54 UTC	LIGO/Virgo EM Follow-Up	New VOEvent S190510g-3-Update.xml
May 10, 2019 10:22:52 UTC	LIGO/Virgo EM Follow-Up	User leo.singer@LIGO.ORG queued a Preliminary alert through the dashboard.
May 10, 2019 05:25:10 UTC	Qi Chu	Advocate signoff certified status as OK: 'Found by GstLAL. The FAR passed the OPA threshold. Caution: There is a glitch in L1 from 7s before the trigger. DetChar thinks is OK. Pipeline experts have some concerns. Skymap is quite spread out possibly due to low-SNR and data quality issues. Need more investigation offline from data quality, pipelines, and parameter estimation.'; label ADVREQ removed and label ADVOK applied
May 10, 2019 05:25:07 UTC	LIGO/Virgo EM Follow-Up	Template for initial GCN Circular initial-circular.txt
May 10, 2019 05:24:59 UTC	LIGO/Virgo EM Follow-Up	New VOEvent S190510g-2-Initial.xml
May 10, 2019 04:24:49 UTC	LIGO/Virgo EM Follow-Up	Template for preliminary GCN Circular preliminary-circular.txt
May 10, 2019 04:18:37 UTC	Deep Chatterjee	New VOEvent S190510g-1-Preliminary.xml
May 10, 2019 04:03:37 UTC	LIGO/Virgo EM Follow-Up	User deep.chatterjee@LIGO.ORG queued a Preliminary alert through the dashboard.

```
SUBJECT: LIGO/Virgo S190510g: Identification of a GW compact binary merger candidate
The LIGO Scientific Collaboration and the Virgo Collaboration report:


We identified the compact binary merger candidate S190510g during
real-time processing of data from LIGO Hanford Observatory (H1), LIGO
Livingston Observatory (L1), and Virgo Observatory (V1) at 2019-05-10
02:59:39.292 UTC (GPS time: 1241492397.292). The candidate was found
by the GstLAL [1] analysis pipeline.

S190510g is an event of interest because its false alarm rate, as
determined by the online analysis, is 8.4e-10 Hz, or about one in 37
years. The event's properties can be found at this URL:

https://gracedb.ligo.org/superevents/S190510g

The classification of the GW signal, in order of descending
probability, is BNS (98%), Terrestrial (2%), NSBH (<1%), BBH (<1%), or
MassGap (<1%).

Assuming the candidate is astrophysical in origin, there is strong
evidence for the lighter compact object having a mass < 3 solar masses
(HasNS: >99%). Using the masses and spins inferred from the signal,
there is strong evidence for matter outside the final compact object
(HasRemnant: >99%).

No skymaps are available at this time.


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

 [1] Messick et al. PRD 95, 042001 (2017)
```

Sign up!

Volunteers are needed!

				Rota Schedule		
Schedule	**Start**	**End**	**Advocate**	**Advocate**	**Advocate**	**Advocate (stand-by)**
1	April 5	April 12	Leo Singer	Peter Shawhan	Sarah Antier	Shasvath
2	April 12	April 16	Brandon	Linqing	Erik	
3	April 17	April 21	Erik			
4	April 22	April 26	Deep	Shaon	Leo Singer	
5	April 26	May 3	Shaon	Leo Singer	Sarah Antier	
6	May 3	May 10	Qi Chu (Chichi)	Shasvath	Shaon	Erik
7	May 10	May 17	Deep	Marco Drago	Shaon	
8	May 17	May 24	Brandon	Roberto	Geoffrey	Shasvath
9	**May 24**	**May 31**	**John Vietch**	**Karelle**	**Leo Singer**	**Erik**
10	May 31	June 7	Peter Shawhan	Kipp Cannon	Marco Cavaglia	
11	June 7	June 14	Alan Weinstein	Marek Szczepańczyk	Soichiro Morisaki	
12	June 14	June 21	Marica Branchesi	Salvo	Leo Tsukada	
13	June 21	June 28	Barbara Patricelli	Surabhi	Liting Xiao	
14	June 28	July 5	Sathya	Daniel Holz	Brandon	

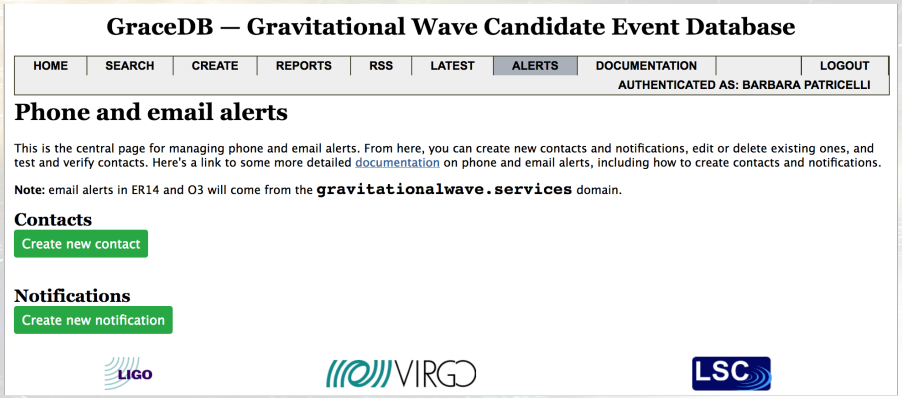
Contact: Shaon Ghosh, shaon.physics@gmail.com

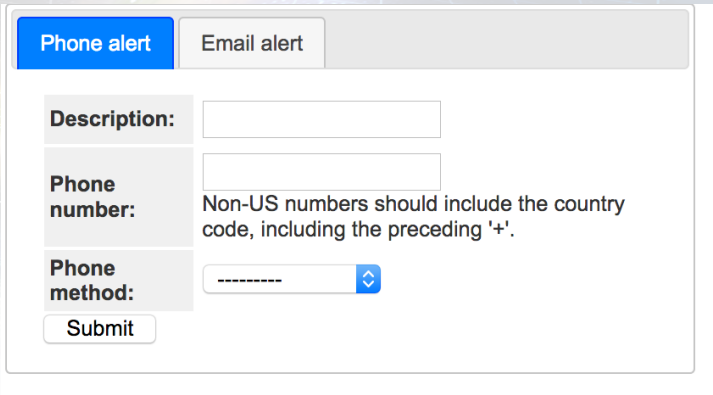
Backup

Before your shift:

To receive phone and email alerts:

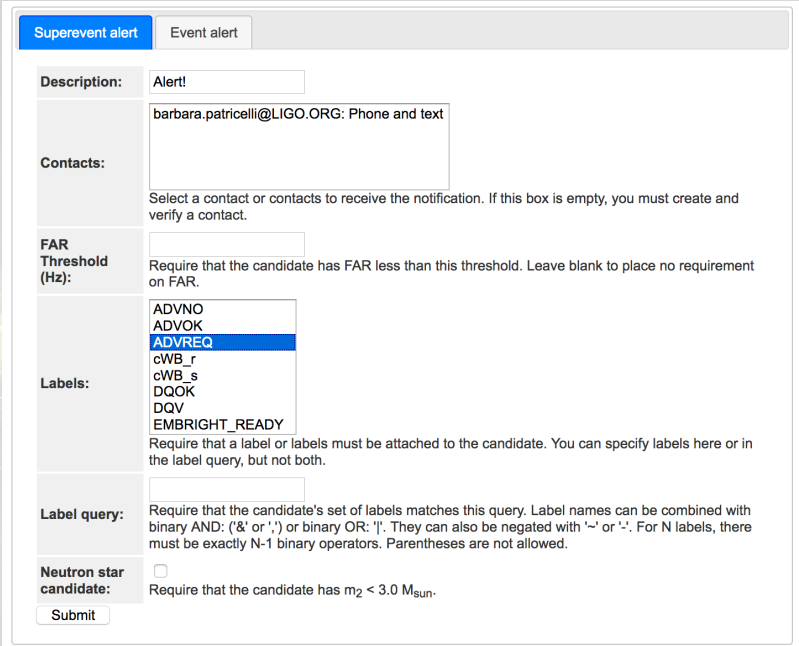
- Go to `https://gracedb.ligo.org` and log in using your ligo.org credentials.
- Go to the ALERTS tab.
- Follow the Create New Contact link.





Before your shift:

Now click on the Create new notification button



You should create two supervents alerts: one for the label "**ADVREQ**" and the other for the label "**EM_COINC**".

The Rapid Response Team

RRT comprises:

- Team Leads: One Site Advocate from each site (LLO, LHO, Virgo).
- Operators on shift from LIGO and Virgo sites.
- An online EM Advocate.
- At least one pipeline expert for the triggering analysis.
- DetChar experts from LIGO as well as Virgo.
- A GraceDB expert.

Each group provides in advance a shift calendar for RRT including the name, email address and cell phone number of a person on shift and at least one backup.

`https://dcc.ligo.org/DocDB/0155/L1800241/006/L1800241-O3RRTPolicy_v06.pdf`