GWCelery Documentation

Release 0.1.2

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Contents:

GWCelery is a simple and reliable package for annotating and orchestrating LIGO/Virgo alerts, built from widely used open source components.

CHAPTER 1

Quick start

1.1 To install

GWCelery requires Python >= 3.6.

The easiest way to install it is with `venv` and `pip`:

```
$ python -m venv --system-site-packages ~/gwcelery
$ source ~/gwcelery/bin/activate
$ pip install gwcelery
```

- **Note:** GWCelery requires a fairly new version of `setuptools`. If you get an error message that looks like this:

  ```
  pkg_resources.VersionConflict: (setuptools 0.9.8 (gwcelery/lib/python2.7/site-
  ↪packages), Requirement.parse('setuptools>=30.3.0'))
  ```

  then run `pip install --upgrade setuptools` and try again.

1.2 To test

With `setup.py`:

```
$ python setup.py test
```

1.3 To start

NOTE that GWCelery requires redis. Your package manager (apt, yum, macports) should be able to install, configure, and automatically launch a suitable redis server, but otherwise you can use the Redis Quick Start instructions to build redis and start a server:

```
$ wget http://download.redis.io/redis-stable.tar.gz
$ tar xvzf redis-stable.tar.gz
$ cd redis-stable
$ make -j
$ src/redis-server
```

GWCelery itself consists of four workers:

```
$ gwcelery worker -l info -n gwcelery-worker -Q celery -B
$ gwcelery worker -l info -n gwcelery-openmp-worker -Q openmp -c 1
$ gwcelery worker -l info -n gwcelery-superevent-worker -Q superevent -c 1
    $ gwcelery worker -l info -n gwcelery-exttrig-worker -Q exttrig -c 1
```

CHAPTER 2

Configuration

By default, GWCelery will talk to the playground GraceDb server, `gracedb-playground.ligo.org`. To switch to using the production GraceDb server, `gracedb.ligo.org`, set the following environment variable before starting GWCelery:

```
CELERY_CONFIG_MODULE=gwcelery.conf.production
```

For further customization, see the API documentation for the `gwcelery.conf` module.

CHAPTER 3

Monitoring and Management

Like all Celery applications, GWCelery supports a rich selection of management and monitoring tools. Here is an introduction to a few of them.

3.1 Flower

Flower is a dashboard for monitoring Celery tasks. To start Flower for monitoring during local development, run the following command and then navigate to http://localhost:5555/ in your browser:

```
$ gwcelery flower
```

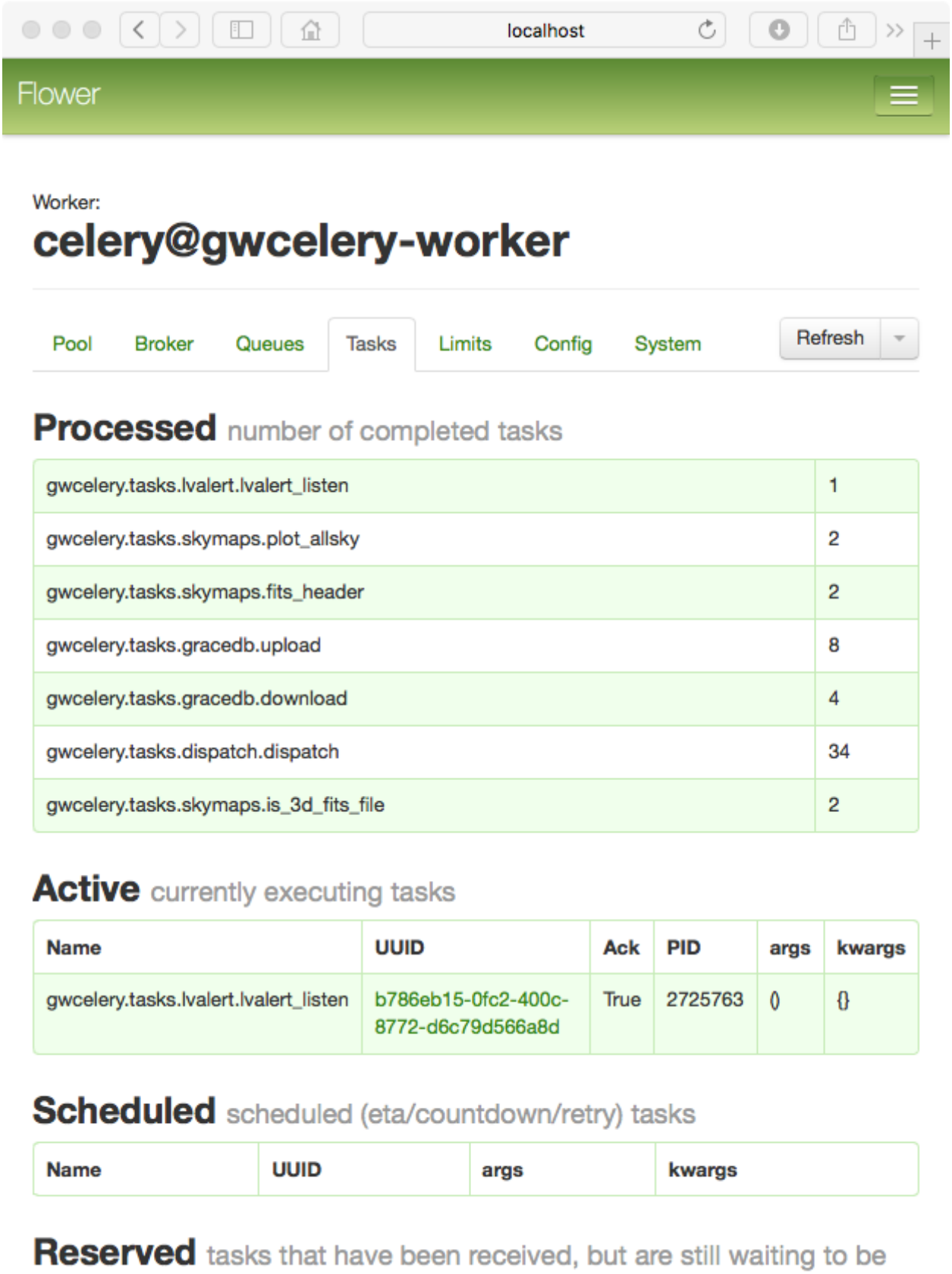
To set up monitoring on a LIGO Data Grid cluster machine (e.g. `emfollow.ligo.caltech.edu`) protected by LIGO.org authentication, start Flower using the following command:

```
$ gwcelery flower --url-prefix=~${USER}/gwcelery
```

add the following lines to the file `~/public_html/.htaccess`:

```
RewriteEngine on
RewriteRule ^gwcelery/?(.*)$ http://emfollow.ligo.caltech.edu:5555/$1 [P]
```

Some additional firewall configuration may be required.


localhost
Flower
Worker:
celery@gwcelery-worker
Pool
Broker
Queues
Tasks
Limits
Config
System
Refresh
Processed number of completed tasks
gwcelery.tasks.lvalert.lvalert_listen 1
gwcelery.tasks.skymaps.plot_allsky 2
gwcelery.tasks.skymaps.fits_header 2
gwcelery.tasks.gracedb.upload 8
gwcelery.tasks.gracedb.download 4
gwcelery.tasks.dispatch.dispatch 34
gwcelery.tasks.skymaps.is_3d_fits_file 2
Active currently executing tasks
Name UUID Ack PID args kwargs
gwcelery.tasks.lvalert.lvalert_listen b786eb15-0fc2-400c-8772-d6c79d566a8d True 2725763 () {}
Scheduled scheduled (eta/countdown/retry) tasks
Name UUID args kwargs
Reserved tasks that have been received, but are still waiting to be

3.2 Command-Line Tools

All Celery application provide command-line monitoring and management utilities, including the following:

- `gwcelery shell`: Start an interactive Python or IPython interpreter for interacting with Celery. All tasks as well as the `app` application instance are automatically imported and available as globals. Example:

```
$ gwcelery shell
Python 3.6.6 (default, Jun 28 2018, 05:43:53)
Type 'copyright', 'credits' or 'license' for more information
IPython 6.5.0 -- An enhanced Interactive Python. Type '?' for help.

In [1]: download.s('coinc.xml', 'M6757').delay().get()
```

- `gwcelery call`: Call a task from the command line by passing it arguments in JSON format. The output is the unique identifier of the result. Example:

```
$ gwcelery call gwcelery.tasks.gracedb.download --args='["coinc.xml", "M6757"]'
d11099e7-75e5-4aa3-800b-b122b667757c
```

- `gwcelery result`: Get the result of a previously called task. Example:

```
$ gwcelery result ab4aa6d7-9f21-420c-8401-cbe6863cf7dc
(b'<?xml version=\'1.0\' encoding=\'utf-8\'?>\n<!DOCTYPE LIGO_LW SYSTEM "htt'
 b'p://ldas-sw.ligo.caltech.edu/doc/ligolwAPI/html/ligolw_dtd.txt">\n<LIGO_L'
 ...
 b'\t</Stream>\n\t</Table>\n</LIGO_LW>\n')
```

3.3 Nagios

This tool is specific to GWCelery.

The dashboard.ligo.org and monitor.ligo.org services use Nagios to monitor and report on the health of all of the components of the low-latency analysis infrastructure.

GWCelery provides the command `gwcelery nagios` to check the status of the application and provide a report in the format that Nagios expects.

You can run it manually from the command line:

```
$ gwcelery nagios
OK: GWCelery is running normally
```

To configure Nagios itself, see the Nagios configuration overview, or if GWCelery and Nagios are running on different hosts, the Nagios Remote Plugin Executor (NRPE) documentation

CHAPTER 4

Running under HTCondor

The recommended way to start and stop GWCelery on the LIGO Data Grid cluster is using HTCondor. See the example HTCondor submit file `gwcelery.sub`. This submit file will start up Redis, the worker processes, and Flower. It will create some log files and a Unix domain socket, so you should first navigate to a directory where you want these files to go. For example:

```
$ mkdir -p ~/gwcelery/var && cd ~/gwcelery/var
```

Then run the submit file as follows:

```
$ gwcelery.sub
Submitting job(s)......
6 job(s) submitted to cluster 293497.
```

To stop GWCelery, run the `condor_hold` command:

```
$ condor_hold -constraint 'JobBatchName == "gwcelery"'
All jobs matching constraint (JobBatchName == "gwcelery") have been held
```

To restart GWCelery, run `condor_release`:

```
$ condor_release -constraint 'JobBatchName == "gwcelery"'
All jobs matching constraint (JobBatchName == "gwcelery") have been released
```

Note that there is normally **no need** to re-submit GWCelery if the machine is rebooted, because the jobs will persist in the HTCondor queue.

4.1 Shortcuts

The following commands are provided as shortcuts for the above operations:

```
$ gwcelery condor submit
$ gwcelery condor rm
$ gwcelery condor q
$ gwcelery condor hold
$ gwcelery condor release
```

The following command is a shortcut for `gwcelery condor rm; gwcelery condor submit`:

```
$ gwcelery condor resubmit
```

CHAPTER 5

Contributing

Contributors may familiarize themselves with Celery itself by going through the First Steps with Celery tutorial.

5.1 Development model

GWCelery operates on a fork-and-merge development model (see GitLab basics for an introduction).

To contribute to GWCelery development, follow these steps:

1. Create a personal fork of GWCelery.
2. Make your changes on a branch.
3. Open a merge request.

Note that GWCelery uses fast-forward merges.

5.2 Where new code should go

New code will generally consist of adding Celery tasks. Tasks are organized by functionality into submodules of `gwcelery.tasks`. If your new task does not match with one of the existing submodules, please create a new submodule.

5.3 Guidelines for tasks

- **Tasks should be short.** When deciding where a new task should go, start from the following loose rules of thumb:
    1. If it's less than a screenful of code, and related to functionality in an existing module, then put the code in a new task in that module.

2. If it's up to a few screenfuls of code, or not related to functionality in an existing module, then try to break it into a few smaller functions or tasks and put it in a new module.
3. If it's more than a few screenfuls of code, or adds many additional dependencies, then it should go in a separate package.

See also the note on granularity in the Celery manual's "Tips and Best Practices" section.

- **Tasks should avoid saving files to disk.** Output should be placed directly in GraceDb. Temporary files that are written in `/tmp` are OK but should be cleaned up promptly.

  See also the Celery manual's notes on data locality and state.

- **Dependencies should be installable by pip.** Dependencies of tasks should be listed in the `install_requires` section in `setup.cfg` so that they are installed automatically when GWCelery is installed with `pip`.

5.4 Unit tests

Unit tests and code coverage measurement are run automatically for every branch and for every merge request. New code contributions must have 100% test coverage. Modifications to existing code must not decrease test coverage. To run the unit tests and measure code coverage, run the following commands in the top directory of your local source checkout:

```
$ pip install pytest-cov
$ python setup.py test --addopts='--cov --cov-report html'
```

This will save a coverage report that you can view in a web browser as `htmlcov/index.html`.

5.5 Code style

Code should be written in the PEP 8 style and must pass linting by Flake8. To check code style, run the following commands in the top of your source directory:

```
$ pip install flake8 pep8-naming
$ flake8 --show-source .
```

5.6 Documentation

Documentation strings should be written in the Numpydoc style.

CHAPTER 6

Design and anatomy of GWCelery

6.1 Processes

A complete deployment of GWCelery (whether launched from the *shell* or from *HTCondor*) consists of several processes:

1. **Message Broker**

   Routes and distributes Celery task messages and stores results of tasks for later retrieval. See Choosing a Broker in the Celery manual for more details. For technical reasons, we use a Redis broker.

2. **Celery Beat**

   Scheduler for periodic tasks (the Celery equivalent of cron jobs). For more information, see Periodic Tasks in the Celery manual.

3. **Monitoring Console** (optional)

   You can optionally run Flower, a web monitoring console for Celery.

4. **OpenMP Worker**

   A Celery worker that has been configured to accept only computationally intensive tasks that use OpenMP parallelism. To route a task to the OpenMP worker, pass the keyword argument `queue='openmp'` to the `@app.task` decorator when you declare it.

   There are two tasks that run in the OpenMP queue:

   - `gwcelery.tasks.bayestar.localize()`
   - `gwcelery.tasks.skymaps.plot_volume()`

5. **Superevent Worker**

   A Celery worker that is dedicated to serially process triggers from low latency pipelines and create/modify superevents in GraceDb. There is only one task that runs on the Superevent queue:

   - `gwcelery.tasks.superevents.handle()`

6. **External Trigger Worker**

   A Celery worker that is dedicated to serially process external triggers from GRB alerts received from Fermi, Swift and neutrino alerts received from SNEWS and create/modify external trigger events in GraceDb:

   - `gwcelery.tasks.external_triggers.handle_gcn()`

7. **General-Purpose Worker**

   A Celery worker that accepts all other tasks.

6.2 Eternal tasks

GWCelery has a couple long-running tasks that do not return because they have to keep open a persistent connection with some external service. These tasks are subclasses of `celery_eternal.EternalTask` or `celery_eternal.EternalProcessTask`.

- `gwcelery.tasks.gcn.broker()`
- `gwcelery.tasks.gcn.listen()`
- `gwcelery.tasks.lvalert.listen()`

Both of these run inside the general-purpose worker process described above, and are automatically started (and restarted as necessary) by Celery Beat.

6.3 Handlers

A recurring pattern in GWCelery is that an eternal task listens continuously to a remote connection, receives packets of data over that connection, and dispatches further handling to other tasks based on packet type.

A decorator is provided to register a function as a Celery task and also plug it in as a handler for one or more packet types. This pattern is used for both GCN notices and LVAlert message handlers.

6.3.1 GCN notices

GCN notice handler tasks are declared using the `gwcelery.tasks.gcn.handler()` decorator:

```
import lxml.etree
from gwcelery.tasks import gcn

@gcn.handler(gcn.NoticeType.FERMI_GBM_GND_POS,
             gcn.NoticeType.FERMI_GBM_FIN_POS)
def handle_fermi(payload):
    root = lxml.etree.fromstring(payload)
    # do work here...
```

6.3.2 LVAlert messages

LVAlert message handler tasks are declared using the `gwcelery.tasks.lvalert.handler()` decorator:

```
from gwcelery.tasks import lvalert

@lvalert.handler('cbc_gstlal',
                 'cbc_spiir',
                 'cbc_pycbc',
                 'cbc_mbtaonline')
def handle_cbc(alert):
    # do work here...
```

CHAPTER 7

API Reference

7.1 gwcelery.conf module

7.1.1 gwcelery.conf.development module

7.1.2 gwcelery.conf.playground module

7.1.3 gwcelery.conf.production module

7.1.4 gwcelery.conf.test module

7.2 gwcelery.sentry module

7.3 gwcelery.tasks module

7.3.1 gwcelery.tasks.bayestar module

7.3.2 gwcelery.tasks.circulars module

7.3.3 gwcelery.tasks.condor module

7.3.4 gwcelery.tasks.detchar module

7.3.5 gwcelery.tasks.em_bright module

7.3.6 gwcelery.tasks.external_triggers module

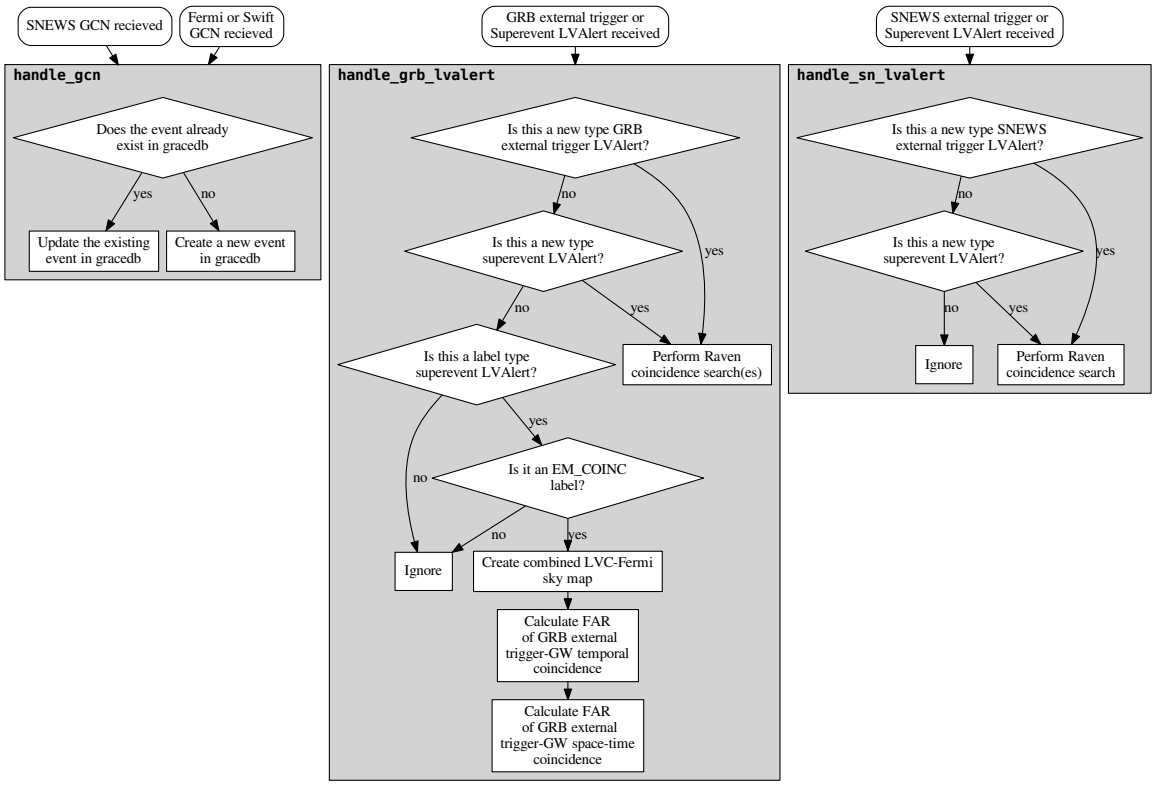
This module listens to the *GCNs* from SNEWS and the Fermi and Swift missions. It is also responsible for carrying out tasks related to external trigger-gravitational wave coincidences, including looking for temporal coincidences, creating

combined GRB-GW sky localization probability maps, and computing their joint temporal and spatio-temporal false alarm rates.

There are two GCN and two LVAlert message handlers in the *~gwcelery.tasks.external_triggers* module:

- `handle_sn_gcn()` is called for each SNEWS GCN.
- `handle_grb_gcn()` is called for each Fermi and Swift GCN.
- `handle_sn_lvalert()` is called for each SNEWS external trigger and superevent LVAlert.
- `handle_grb_lvalert()` is called for each Fermi and Swift external trigger and superevent LVAlert.

Flow Chart



Tasks

7.3.7 gwcelery.tasks.ligo_fermi_skymaps module

7.3.8 gwcelery.tasks.gcn module

7.3.9 gwcelery.tasks.gcn.validate module

7.3.10 gwcelery.tasks.gracedb module

7.3.11 gwcelery.tasks.lvalert module

7.3.12 gwcelery.tasks.orchestrator module

This module implements the alert orchestrator, which responsible for the vetting and annotation workflow to produce preliminary, initial, and update alerts for gravitational-wave event candidates.

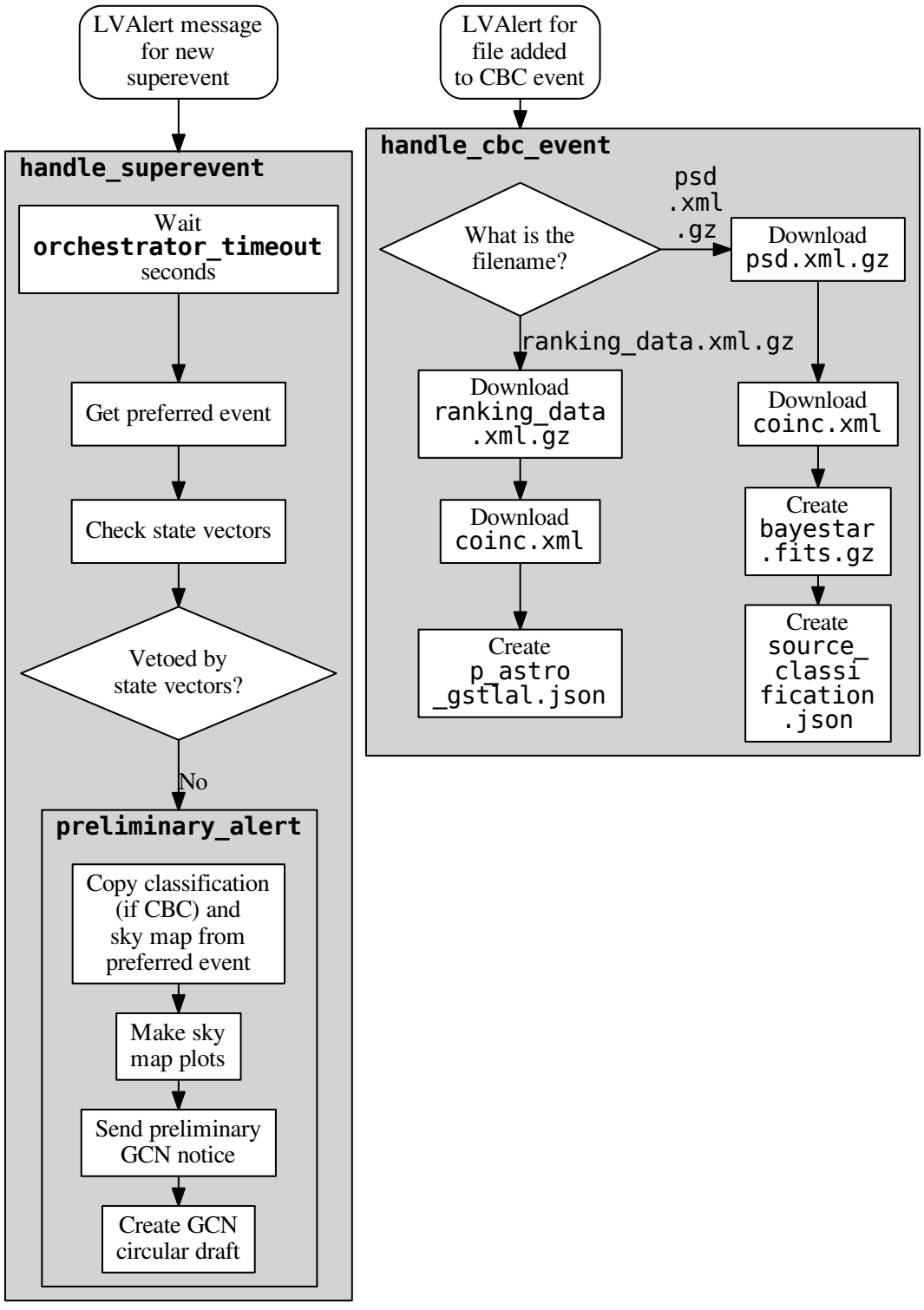
The orchestrator consists of two LVAlert message handlers:

- `handle_superevent()` is called for each superevent. It waits for a short duration of `orchestrator_timeout` seconds for the selection of the superevent by the `superevent manager` to stabilize, then performs data quality checks. If the data quality checks pass, then it calls `preliminary_alert()` to copy annotations from the preferred event and send the preliminary GCN notice.
- `handle_cbc_event()` is called for each CBC event. It performs some CBC-specific annotations that depend closely on the CBC matched-filter parameters estimates and that might influence selection of the preferred event: rapid sky localization with BAYESTAR and rapid source classification.

  Note that there is no equivalent of this task for burst events because both burst searches (cWB, LIB) have integrated source localization and have no other annotations.

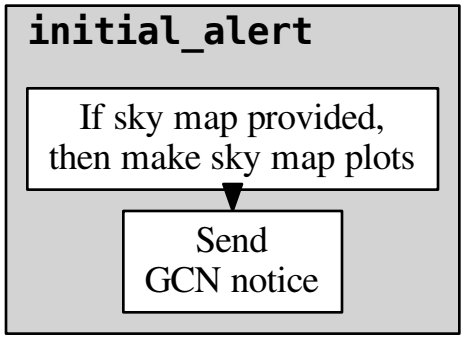
Preliminary Alerts

The flow chart below illustrates the operation of these two tasks.


LVAlert message for new superevent
handle_superevent
Wait orchestrator_timeout seconds
Get preferred event
Check state vectors
Vetoed by state vectors?
No
preliminary_alert
Copy classification (if CBC) and sky map from preferred event
Make sky map plots
Send preliminary GCN notice
Create GCN circular draft
LVAlert for file added to CBC event
handle_cbc_event
What is the filename?
psd.xml.gz
Download psd.xml.gz
ranking_data.xml.gz
Download ranking_data.xml.gz
Download coinc.xml
Create p_astro_gstlal.json
Download coinc.xml
Create bayestar.fits.gz
Create source_classification.json

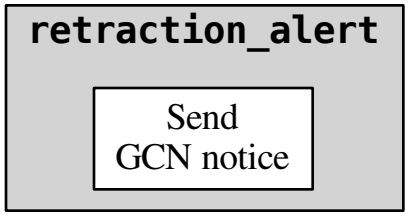
Initial and Update Alerts

The `initial_alert()` and `update_alert()` tasks create Initial and Update alerts respectively. At the moment, there is no handler or user interface to trigger these tasks, and they must be invoked manually (see *Command-Line Tools*). A flow chart for the initial alerts is shown below; the flow chart for update alerts is the same.



Retraction Alerts

Likewise, the `retraction_alert()` task creates Retraction alerts, and at the moment must be invoked manually. A flow chart is shown below.



Tasks

7.3.13 gwcelery.tasks.p_astro_gstlal module

7.3.14 gwcelery.tasks.raven module

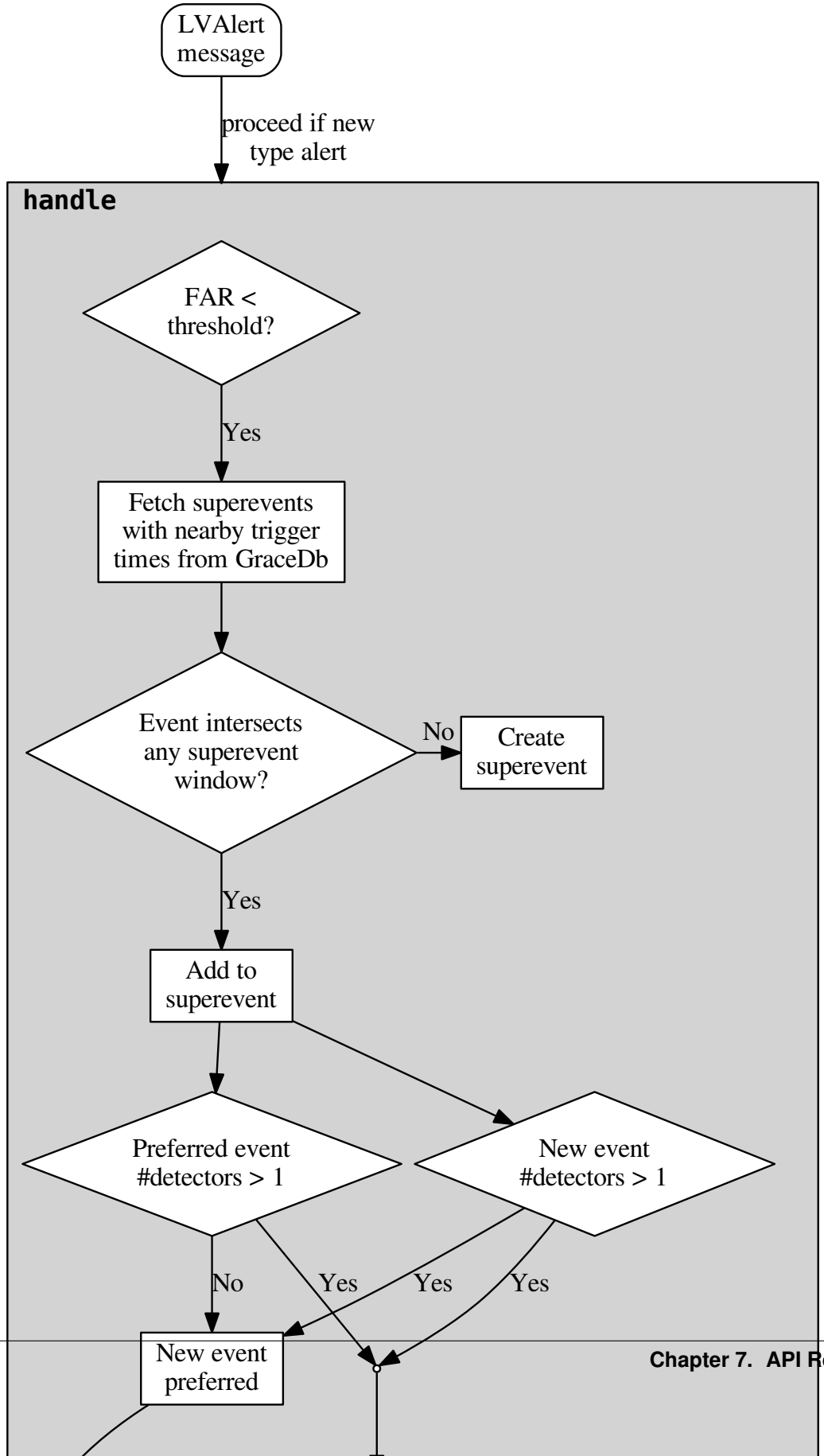
7.3.15 gwcelery.tasks.skymaps module

7.3.16 gwcelery.tasks.superevents module

Superevents are a new abstraction of gravitational-wave candidates introduced in the third LIGO/Virgo observing (O3). Each superevent is intended to represent a single astrophysical event. A superevent consists of one or more event candidates, possibly from different pipelines, that are neighbors in `gpstime`. One event belonging to the superevent is identified as the preferred event.

Flow Chart

The flow chart below illustrates the decision process for selection of the preferred event.


LVAlert message
proceed if new type alert
handle
FAR < threshold?
Yes
Fetch superevents with nearby trigger times from GraceDb
Event intersects any superevent window?
No
Create superevent
Yes
Add to superevent
Preferred event #detectors > 1
New event #detectors > 1
No
Yes
Yes
Yes
New event preferred

Tasks

7.4 gwcelery.util module

CHAPTER 8

Changelog

8.1 0.1.2 (2018-10-11)

- Setted `vetted` flag to true for all initial, update, and retraction alerts that are triggered by GraceDb signoffs.
- Write GraceDb signoffs, instead of just labels, to simulate initial and retraction alerts for mock events, because merely creating the `ADVNO` or `ADVOK` label does not cause GraceDb to erase the `ADVREQ` label. This change makes mock alerts more realistic.
- Change filename of cWB sky maps from `skyprobcc_cWB.fits` to `cWB.fits.gz` for consistency with other pipelines.
- Any time that we send a VOEvent, first change the GraceDb permissions on the corresponding superevent so that it is visible to the public. Note that this has no effect during the ongoing software engineering runs because LVEM and unauthenticated access are currently disabled in GraceDb.

8.2 0.1.1 (2018-10-04)

- Use the `public` tag instead of the `lvem` tag to mark preliminary sky maps for public access rather than LV-EM partner access. Note that GraceDb has not yet actually implemented unauthenticated access, so this should have no effect during our ongoing software engineering runs.
- Add `check_idq` function to detchar module, which reads probabilities generated by iDQ.
- Automated `DQV` labels should not trigger retraction notices because they prevent preliminary notices from being sent in the first place.
- The criterion for selecting a superevent's preferred event now prefers multiple-detector events to single-detector events, with precedence over source type (CBC versus burst). Any remaining tie is broken by using SNR for CBC and FAR for Burst triggers.
- By default, initial and update alerts will find and send the most recently added public sky map.
- The initial and update sky maps no longer perform sky map annotations, because they would only be duplicating the annotations performed as part of the preliminary alert.

- Mock events now include example initial and retraction notices. Two minutes after each mock event is uploaded, there will be either an `ADVOK` or an `ADVNO` label applied at random, triggering either an initial or a retraction notice respectively.
- Depend on ligo-gracedb >= 2.0.1 in order to pull in a bug fix for VOEvents with ProbHasNS or ProbHasRemnant set to 0.0.
- Use the `sentry-sdk` package instead of the deprecated `raven` package for Sentry integration.

8.3 0.1.0 (2018-09-26)

- Separated the external GCN listening handlers into two: one that listens to GCNs about SNEWS triggers and another that listens to Fermi and Swift.
- Fixed calls to the raven temporal coincidence search so that search results separate SNEWS triggers from Fermi and Swift.
- Add space-time FAR calculation for GRB and GW superevent coincidences. This only runs when skymaps from both triggers are available to download.
- Add human vetting for initial GCN notices. For each new superevent that passes state vector checks, the `ADVREQ` label is applied. Rapid response team users should set their GraceDb notification preferences to alert them on `ADVREQ` labels. If a user sets the `ADVOK` label, then an initial notice is issued. If a user sets the `ADVNO` label, then a retraction notice is issued.
- Update the LVAlert host for gracedb-playground.ligo.org.
- Add experimental integration with Sentry for log aggregation and error reporting.
- Track API and LVAlert schema changes in ligo-gracedb 2.0.0.

8.4 0.0.31 (2018-09-04)

- Refactor external trigger handling to separate it from the orchestrator.
- Fixed a bug in the VOEvent broker to only issue "iamalive" messages after sending the first VOEvent.
- Pass group argument to set time windows appropriately when performing raven coincidence searches. Search in the [-600, 60]s range and [-5, 1]s range around external triggers for Burst events and CBC events respectively. Similarly, search in the [-60, 600]s and [-1, 5]s range around Burst and CBC events for external triggers.
- Compute and upload FAR for GRB external trigger/superevent coincidence upon receipt of the EM_COINC label application to a superevent.
- Add continuous integration testing for Python 3.7, and run test suite against all supported Python versions (3.6, 3.7).
- Update ligo.skymap to 0.0.15.

8.5 0.0.30 (2018-08-02)

- Manage superevents for production, test, and MDC events separately.
- Add some more validation of LIGO/Virgo VOEvents from GCN.
- Remove now-unused task `gwcelery.tasks.orchestartor.continue_if`.

- Add `check_vectors` run for external triggers.
- Change the preferred event selection criteria for burst events to be FAR instead of SNR.
- Add `gwcelery nagios` subcommand for Nagios monitoring.
- Incorporate Virgo DQ veto streams into `check_vectors`
- Update ligo-raven to 1.3 and ligo-followup-advocate to 0.0.11.

8.6 0.0.29 (2018-07-31)

- Add a workflow graph to superevents module documentation.
- Add `gwcelery condor resubmit` as a shortcut for `gwcelery condor rm; gwcelery condor submit`.
- Fix deprecation warning due to renaming of `ligo.gracedb.rest.Gracedb.createTag` to `ligo.gracedb.rest.Gracedb.addTag`.
- Update ligo-gracedb to 2.0.0.dev1.

8.7 0.0.28 (2018-07-25)

- Add injection checks to `check_vector`.
- Bitmasks are now defined symbolically in `detchar`.
- Refactor configuration so that it is possible to customize settings through an environment variable.

8.8 0.0.27 (2018-07-22)

- The preferred event for superevents is now decided based on higher SNR value instead of lower FAR in the case of a tie between groups.
- A check for the existence of the gstlal trigger database is performed so that compute_p_astro does not return None.

8.9 0.0.26 (2018-07-20)

- Fix spelling of the label that is applied to events after p_astro finishes, changed from `P_ASTRO_READY` to `PASTRO_READY`.
- Run p_astro calculation for mock events.
- Overhaul preliminary alert pipeline so that it is mostly feature complete for both CBC and Burst events, and uses a common code path for both types. Sky map annotations now occur for both CBC and Burst localizations.
- Switch to using the pre-registered port 8096 for receiving proprietary LIGO/Virgo alerts on emfollow.ligo.caltech.edu. This means that the capability to receive GCNs requires setting up a site configuration in advance with Scott Barthelmey.

  Once we switch to sending public alerts exclusively, then we can switch back to using port 8099 for anonymous access, requiring no prior site configuration.

8.10 0.0.25 (2018-07-19)

- Reintroduce pipeline-dependent pre/post peeks for `check_vector` after fixing issue where pipeline information was being looked for in the wrong dictionary.
- `check_vector` checks all detectors regardless of instruments used, but only appends labels based on active instruments.
- Fix a few issues in the GCN broker:
  - Decrease the frequency of keepalive ("iamalive" in VOEvent Transport Protocol parlance) packets from once a second to once a minute at the request of Scott Barthelmey.
  - Fix a possible race condition that might have caused queued VOEvents to be thrown away unsent shortly after a scheduled keepalive packet.
  - Consume and ignore all keepalive and ack packets from the client so that the receive buffer does not overrun.
- Add `p_astro` computation for `gstlal` pipeline. The copmutation is launched for all cbc_gstlal triggers.

8.11 0.0.24 (2018-07-18)

- Revert pipeline-dependent pre/post peeks for `check_vector` because they introduced a regression: it caused the orchestrator failed without running any annotations.

8.12 0.0.23 (2018-07-18)

- Add timeout and keepalive messages to GCN broker.
- Update ligo-gracedb to 2.0.0.dev0 and ligo.skymap to 0.0.12.
- Add superevent duration for gstlal-spiir pipeline.
- Fix fallback for determining superevent duration for unknown pipelines.
- Make `check_vector` pre/post peeks pipeline dependent.

8.13 0.0.22 (2018-07-11)

- Process gstlal-spiir events.
- Create combined LVC-Fermi skymap in case of coincident triggers and upload to GraceDb superevent page. Also upload the original external trigger sky map to the external trigger GraceDb page.
- Generalize conditional processing of complex canvases by replacing the `continue_if_group_is()` task with a more general task that can be used like `continue_if(group='CBC')`.
- Add a `check_vector_prepost` configuration variable to control how much padding is added around an event for querying the state vector time series.

  This should have the beneficial side effect of fixing some crashes for burst events, for which the bare duration of the superevent segment was less than one sample.

8.14 0.0.21 (2018-07-10)

- MBTA events in GraceDb leave the `search` field blank. Work around this in `gwcelery.tasks.detchar.check_vectors` where we expected the field to be present.
- Track change in GraceDb JSON response for VOEvent creation.

8.15 0.0.20 (2018-07-09)

- After fixing some minor bugs in code that had not yet been tested live, sending VOEvents to GCN now works.

8.16 0.0.19 (2018-07-09)

- Rewrite the GCN broker so that it does not require a dedicated worker.
- Send VOEvents for preliminary alerts to GCN.
- Only perform state vector checks for detectors that were online, according to the preferred event.
- Exclude mock data challenge events from state vector checks.

8.17 0.0.18 (2018-07-06)

- Add detector state vector checks to the preliminary alert workflow.

8.18 0.0.17 (2018-07-05)

- Undo accidental configuration change in last version.

8.19 0.0.16 (2018-07-05)

- Stop listening for three unnecessary GCN notice types: `SWIFT_BAT_ALARM_LONG`, `SWIFT_BAT_ALARM_SHORT`, and `SWIFT_BAT_KNOWN_SRC`.
- Switch to SleekXMPP for the LVAlert client, instead of PyXMPP2. Because SleekXMPP has first-class support for publish-subscribe, the LVAlert listener can now automatically subscribe to all LVAlert nodes for which our code has handlers. Most of the client code now lives in a new external package, sleek-lvalert.

8.20 0.0.15 (2018-06-29)

- Change superevent threshold and mock event rate to once per hour.
- Add `gracedb.create_label` task.
- Always upload external triggers to the 'External' group.
- Add rudimentary burst event workflow to orchestrator: it just generates VOEvents and circulars.

- Create a label in GraceDb whenever `em_bright` or `bayestar` completes.

8.21 0.0.14 (2018-06-28)

- Fix typo that was causing a task to fail.
- Decrease orchestrator timeout to 15 seconds.

8.22 0.0.13 (2018-06-28)

- Change FAR threshold for creation of superevents to 1 per day.
- Update ligo-followup-advocate to >= 0.0.10. Re-enable automatic generation of GCN circulars.
- Add "EM bright" classification. This is rudimentary and based only on the point mass estimates from the search pipeline because some of the EM bright classifier's dependencies are not yet ready for Python 3.
- Added logic to select CBC events as preferred event over Burst. FAR acts as tie breaker when groups for preferred event and new event match.
- BAYESTAR now adds GraceDb URLs of events to FITS headers.

8.23 0.0.12 (2018-06-28)

- Prevent receiving duplicate copies of LVAlert messages by unregistering redundant LVAlert message types.
- Update to ligo-followup-advocate >= 0.0.9 to update GCN Circular text for superevents. Unfortunately, circulars are still disabled due to a regression in ligo-gracedb (see https://git.ligo.org/lscsoft/gracedb-client/issues/7).
- Upload BAYESTAR sky maps and annotations to superevents.
- Create (but do not send) preliminary VOEvents for all superevents. No vetting is performed yet.

8.24 0.0.11 (2018-06-27)

- Submit handler tasks to Celery as a single group.
- Retry GraceDb tasks that raise a `TimeoutError` exception.
- The superevent handler now skips LVAlert messages that do not affect the false alarm rate of an event (e.g. simple log messages).

  (Note that the false alarm rate in GraceDb is set by the initial event upload and can be updated by replacing the event; however replacing the event does not produce an LVAlert message at all, so there is no way to intercept it.)
- Added a query kwarg to superevents method to reduce latency in fetching the superevents from gracedb.
- Refactored getting event information for update type events so that gracedb is polled only once to get the information needed for superevent manager.
- Renamed the `set_preferred_event` task in gracedb.py to `update_superevent` to be a full wrapper around the `updateSuperevent` client function. Now it can be used to set preferred event and also update superevent time windows.

- Many `cwb` (extra) attributes, which should be floating point numbers, are present in lvalert packet as strings. Casting them to avoid embarassing TypeErrors.
- Reverted back the typecasting of far, gpstime into float. This is fixed in https://git.ligo.org/lscsoft/gracedb/issues/10
- CBC `t_start` and `t_end` values are changed to 1 sec interval.
- Added ligo-raven to run on external trigger and superevent creation lvalerts to search for coincidences. In case of coincidence, EM_COINC label is applied to the superevent and external trigger page and the external trigger is added to the list of em_events in superevent object dictionary.
- `cwb` and `lib` nodes added to superevent handler.
- Events are treated as finite segment window, initial superevent creation with preferred event window. Addition of events to superevents may change the superevent window and also the preferred event.
- Change default GraceDb server to https://gracedb-playground.ligo.org/ for open public alert challenge.
- Update to ligo-gracedb >= 1.29dev1.
- Rename the `get_superevent` task to `get_superevents` and add a new `get_superevent` task that is a trivial wrapper around `ligo.gracedb.rest.GraceDb.superevent()`.

8.25 0.0.10 (2018-06-13)

- Model the time extent of events and superevents using the `glue.segments` module.
- Replace GraceDb.get with GraceDb.superevents from the recent dev release of gracedb-client.
- Fix possible false positive matches between GCNs for unrelated GRBs by matching on both TrigID (which is generally the mission elapsed time) and mission name.
- Add the configuration variable `superevent_far_threshold` to limit the maximum false alarm rate of events that are included in superevents.
- LVAlert handlers are now passed the actual alert data structure rather than the JSON text, so handlers are no longer responsible for calling `json.loads`. It is a little bit more convenient and possibly also faster for Celery to deserialize the alert messages.
- Introduce `Production`, `Development`, `Test`, and `Playground` application configuration objects in order to facilitate quickly switching between GraceDb servers.
- Pipeline specific start and end times for superevent segments. These values are controlled via configuration variables.

8.26 0.0.9 (2018-06-06)

- Add missing LVAlert message types to superevent handler.

8.27 0.0.8 (2018-06-06)

- Add some logging to the GCN and LVAlert dispatch code in order to diagnose missed messages.

8.28 0.0.7 (2018-05-31)

- Ingest Swift, Fermi, and SNEWS GCN notices and save them in GraceDb.
- Depend on the pre-release version of the GraceDb client, ligo-gracedb 1.29.dev0, because this is the only version that supports superevents at the moment.

8.29 0.0.6 (2018-05-26)

- Generate GCN Circular drafts using `ligo-followup-advocate`.
- In the continuous integration pipeline, validate PEP8 naming conventions using `pep8-naming`.
- Add instructions for measuring test coverage and running the linter locally to the contributing guide.
- Rename `gwcelery.tasks.voevent` to `gwcelery.tasks.gcn` to make it clear that this submodule contains functionality related to GCN notices, rather than VOEvents in general.
- Rename `gwcelery.tasks.dispatch` to `gwcelery.tasks.orchestrator` to make it clear that this module encapsulates the behavior associated with the "orchestrator" in the O3 low-latency design document.
- Mock up calls to BAYESTAR in test suite to speed it up.
- Unify dispatch of LVAlert and GCN messages using decorators. GCN notice handlers are declared like this:

```
import lxml.etree
from gwcelery.tasks import gcn

@gcn.handler(gcn.NoticeType.FERMI_GBM_GND_POS,
             gcn.NoticeType.FERMI_GBM_FIN_POS)
def handle_fermi(payload):
    root = lxml.etree.fromstring(payload)
    # do work here...
```

  LVAlert message handlers are declared like this:

```
import json
from gwcelery.tasks import lvalert

@lvalert.handler('cbc_gstlal',
                 'cbc_pycbc',
                 'cbc_mbta')
def handle_cbc(alert_content):
    alert = json.loads(alert_content)
    # do work here...
```

- Instead of carrying around the GraceDb service URL in tasks, store the GraceDb host name in the Celery application config.
- Create superevents by simple clustering in time. Currently this is only supported by the `gracedb-dev1` host.

8.30 0.0.5 (2018-05-08)

- Disable socket access during most unit tests. This adds some extra assurance that we don't accidentally interact with production servers during the unit tests.

- Ignore BAYESTAR jobs that raise a `DetectorDisabled` error. These exceptions are used for control flow and do not constitute a real error. Ignoring these jobs avoids polluting logs and the Flower monitor.

8.31 0.0.4 (2018-04-28)

- FITS history and comment entries are now displayed in a monospaced font.
- Adjust error reporting for some tasks.
- Depend on newer version of `ligo.skymap`.
- Add unit tests for the `gwcelery condor submit` subcommand.

8.32 0.0.3 (2018-04-27)

- Fix some compatibility issues between the `gwcelery condor submit` subcommand and the format of `condor_q -totals -xml` with older versions of HTCondor.

8.33 0.0.2 (2018-04-27)

- Add `gwcelery condor submit` and related subcommands as shortcuts for managing GWCelery running under HTCondor.

8.34 0.0.1 (2018-04-27)

- This is the initial release. It provides rapid sky localization with BAYESTAR, sky map annotation, and sending mock alerts.
- By default, GWCelery is configured to listen to the test LVAlert server.
- Sending VOEvents to GCN/TAN is disabled for now.

CHAPTER 9

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CHAPTER 10

Indices and tables

- genindex
- modindex
- search

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