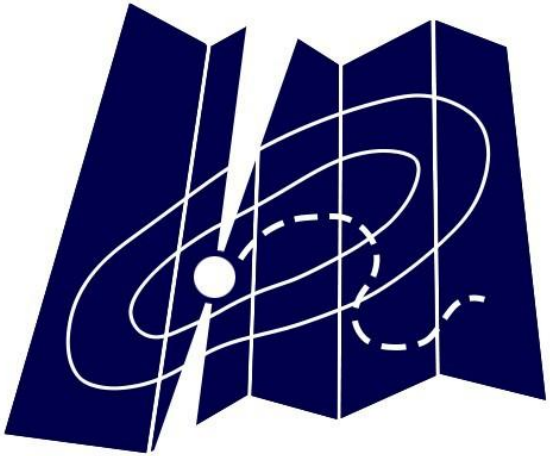
openlvem 04/27/2023

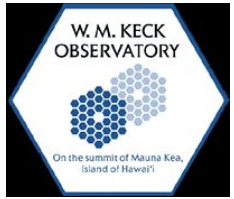


Wyatt et al. 2020: ApJ...894..127W

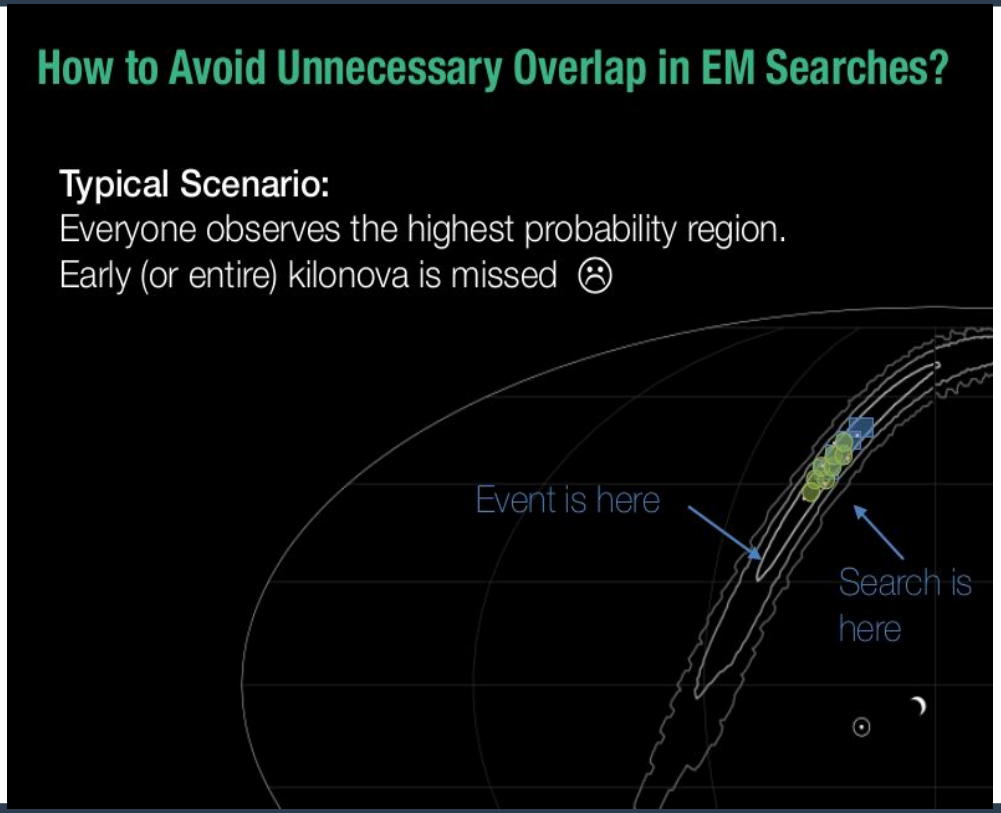
Treasure Map Team

- Samuel Wyatt (dev)
- David Sand
- Michael Lundquist (now at Keck)
- Iair Arcavi
- Aaron Tohuvavohu (dev)
- Andy Howell
- Curtis McCully

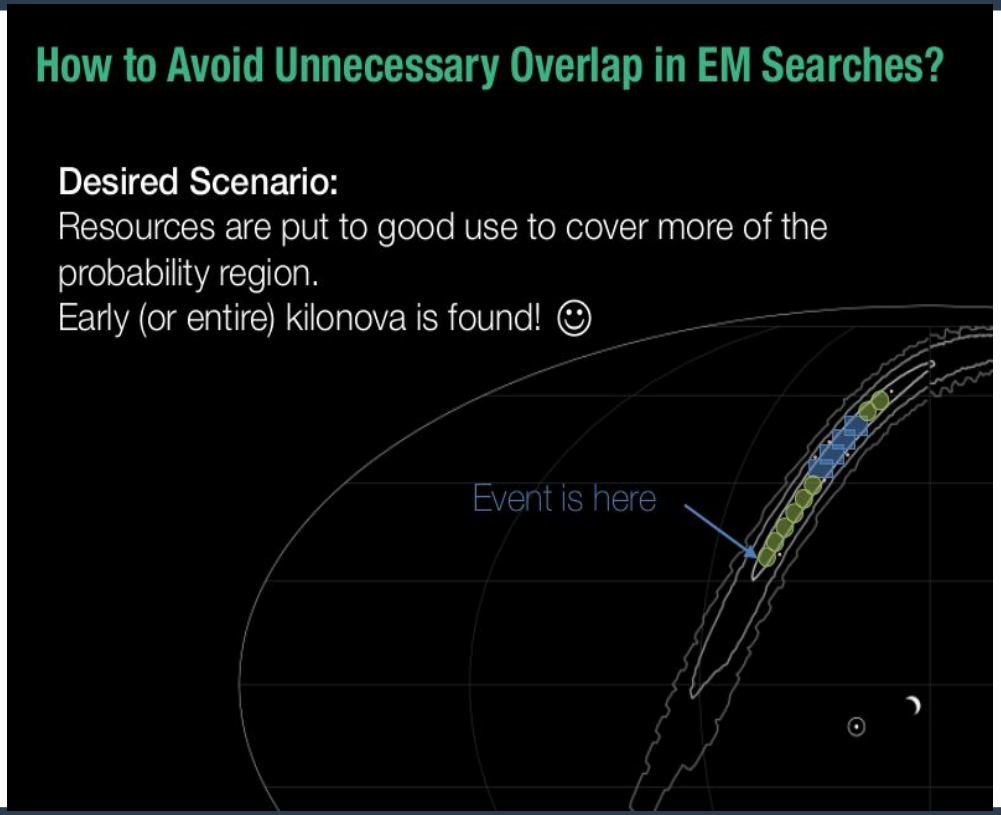



Motivations

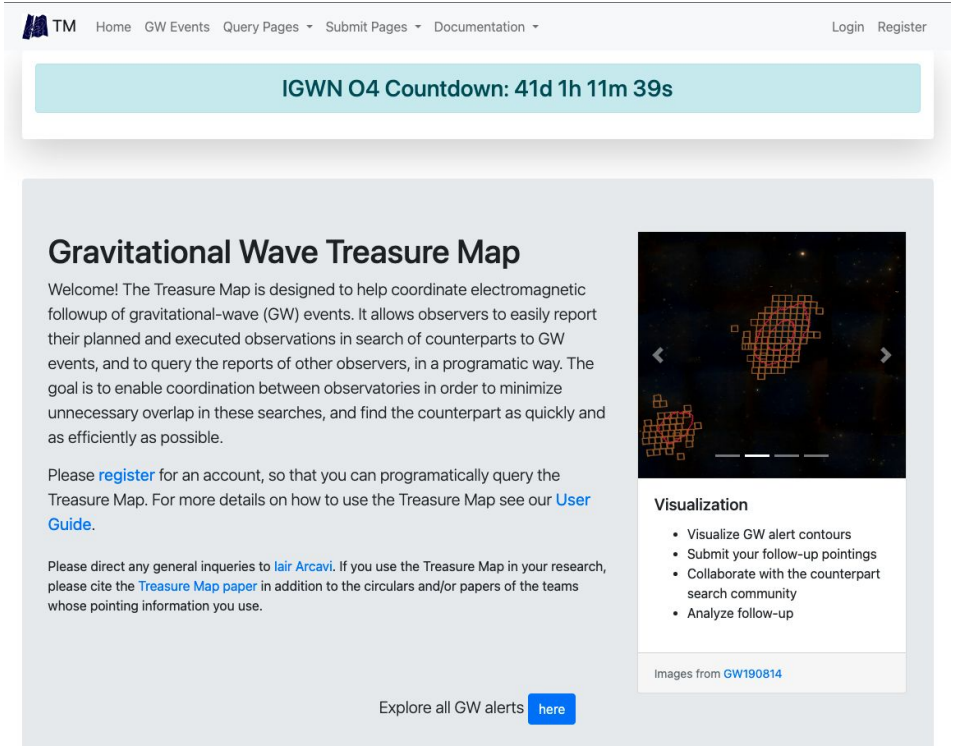


Motivations



GW Treasure Map

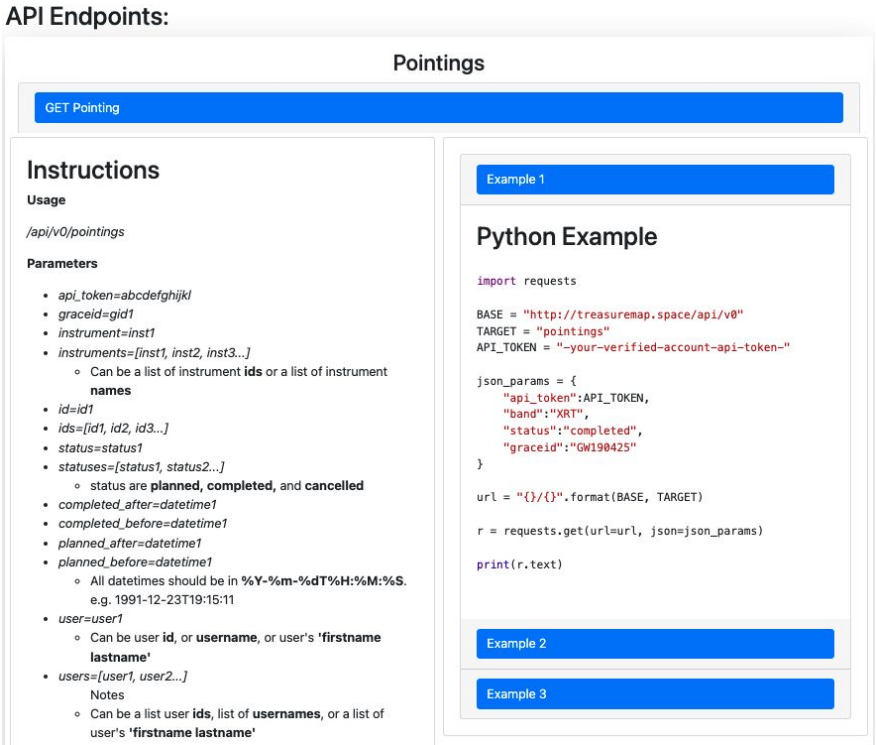
- **Web Based application** (recent facelift)
  - User interface+REST API
  - ALADIN visualization interface (does not require account)
  - Web page querying and submitting for:
    - Instruments, Pointings
      - any submission requires Account registration
- API
  - **Account Registration is required**
  - Fully documented with multiple python examples
  - Endpoint suggestions?
  - python API wrapper coming soon (gwtm_api)



GW Treasure Map

REST API

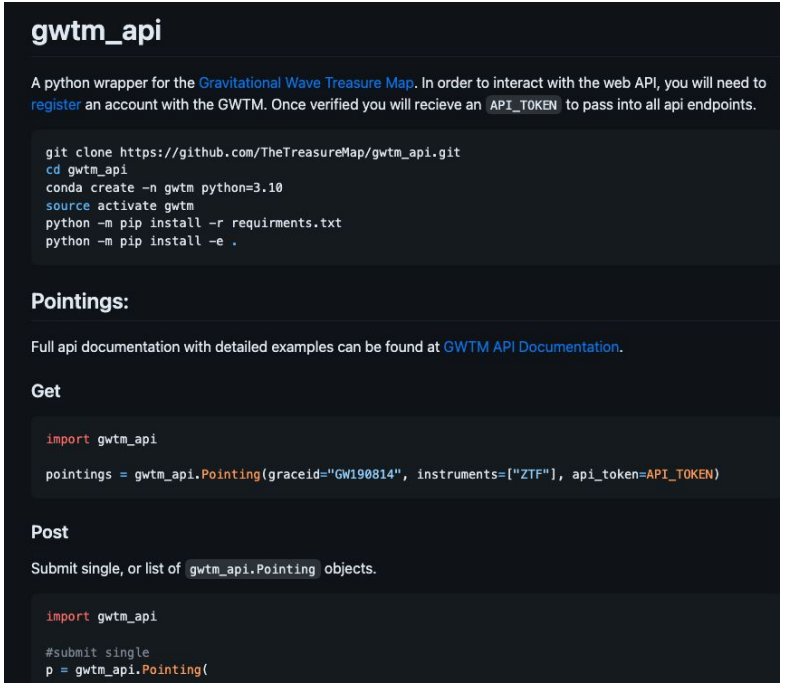
- Ultimately, the primary strength of this tool
  - GET/POST/UPDATE pointing information
    - DOI requests
  - GET Instrument
    - Footprints
  - GET/POST Convolved Galaxies
  - GET MOC files
- Fully Documented on the website with ipython notebook tutorials available.



GW Treasure Map

- In development is a python API wrapper
- Will full encompass all API endpoints for the GWTM in an easier to manage python library

- https://github.com/TheTreasureMap/gwtm_api



gwtm_api

A python wrapper for the Gravitational Wave Treasure Map. In order to interact with the web API, you will need to register an account with the GWTM. Once verified you will recieve an `API_TOKEN` to pass into all api endpoints.

```
git clone https://github.com/TheTreasureMap/gwtm_api.git
cd gwtm_api
conda create -n gwtm python=3.10
source activate gwtm
python -m pip install -r requirments.txt
python -m pip install -e .
```

Pointings:

Full api documentation with detailed examples can be found at GWTM API Documentation.

Get

```
import gwtm_api

pointings = gwtm_api.Pointing(graceid="GW190814", instruments=["ZTF"], api_token=API_TOKEN)
```

Post

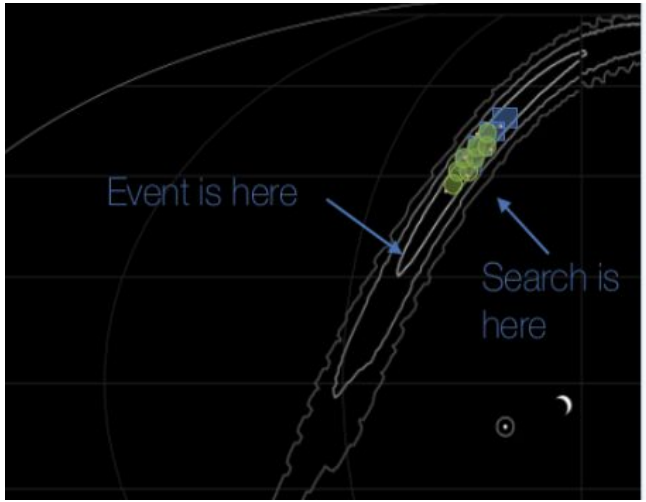
Submit single, or list of `gwtm_api.Pointing` objects.

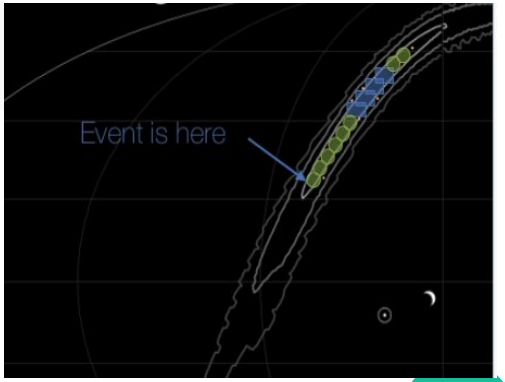
```
import gwtm_api

#submit single
p = gwtm_api.Pointing(
```

GW Treasure Map

REST API

- Ideal use case
  - Team A submits their planned observations
  - Team B queries Team A's observation strategy via the API, and plans their search around Team A, while also submitting to the Treasure Map





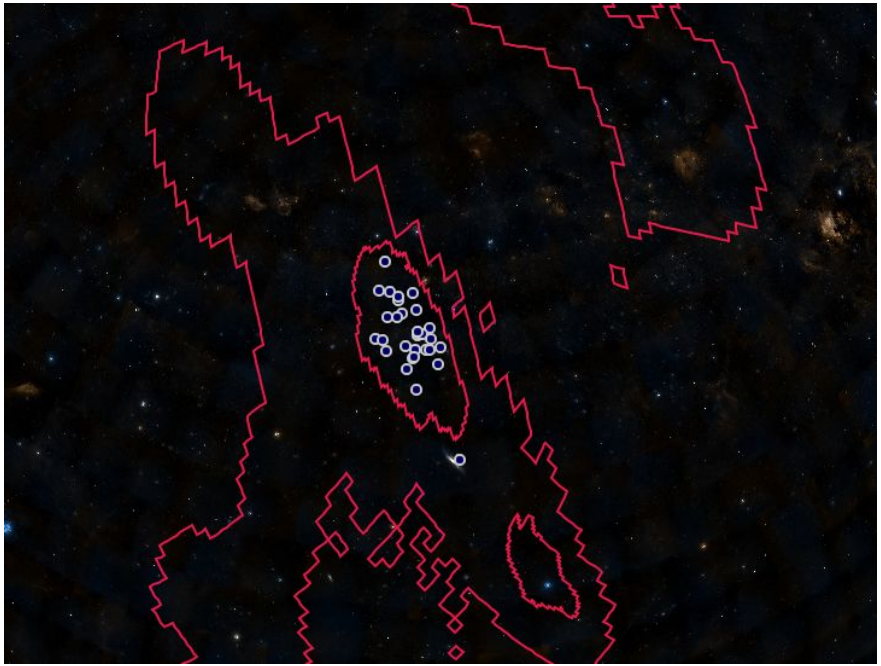
GW Treasure Map

Visualization:

- Interactive ALADIN
  - (BIL, Color Maps, Scroll, Zoom)
- Toggle 90/50 contours and instrument footprints
- Filter pointings
  - (date, range, completed, planned, etc)
- Overlay source info:
  - Convolved Galaxies
  - Known XRT sources
  - Coincident Transients (coming soon)

GW Treasure Map

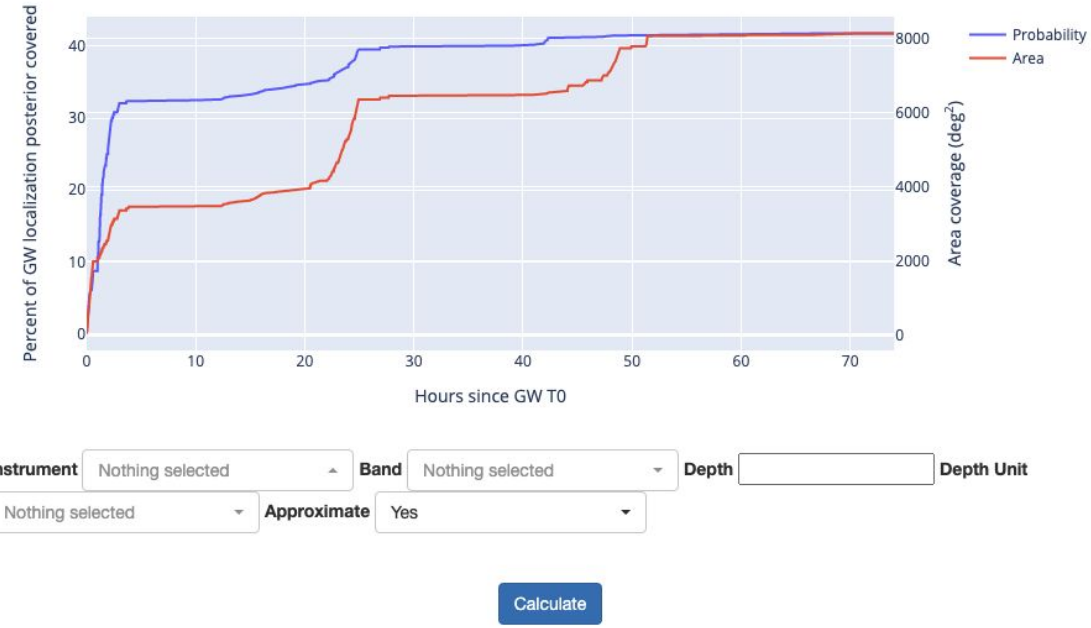
Visualization: Galaxy or Source Information



GW Treasure Map

Coverage Calculator

- Calculates the follow-up coverage of the GW localization over time.
- Can limit the coverage calculation based on:
  - Instruments, wavelengths, depths, etc



GW Treasure Map

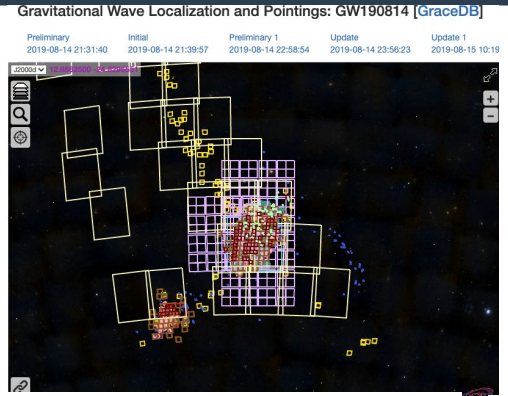
- Highlighted Results from O3
  - ~27,000 completed pointings reported for O3

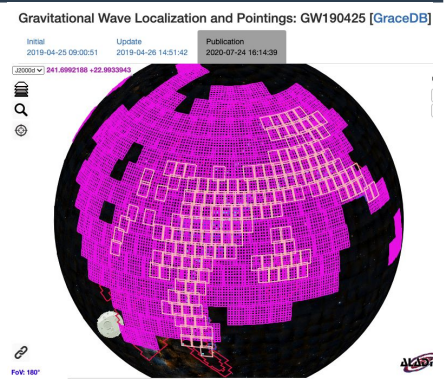
Instruments Reporting

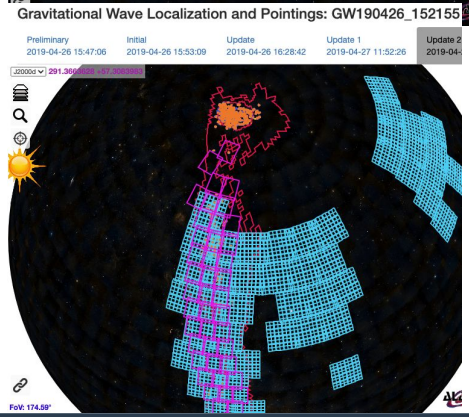
Name	Pointings reported
Swift X-ray Telescope	7803
Swift Ultraviolet/Optical Telescope	6625
Gravitational-wave Optical Transient Observer (GOTO-4 prototype)	2714
ZTF	2586
Swope	1011
MLS10KCCD-CSS	980
Sinistro	728
Thacher ACP Camera	337
Nickel Direct Camera	315
J-GEM/Subaru/Hyper Suprime-Cam	240
Katzman Automatic Imaging Telescope	213
MMTCam	119

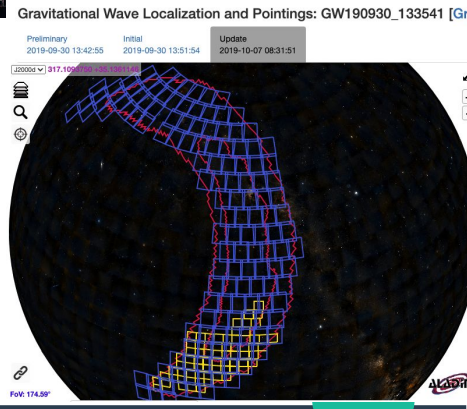
GW Treasure Map

- Highlighted Results from O3
  - GW190930_133541:
    - 91% posterior + 2200sq deg covered
    - 330 pointings
  - GW190814:
    - 98% posterior + 700sq deg covered
    - 4000 pointings
  - GW190426_152155:
    - 75% posterior + 2800sq deg covered
    - 2270 pointings
  - GW190425:
    - 42% posterior + 8100sq deg
    - 2100 pointings



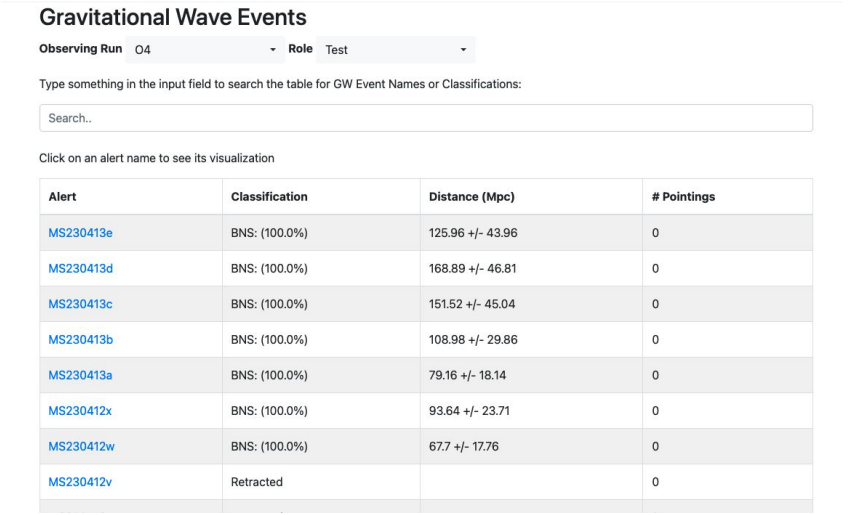






GW Treasure Map

- Currently
  - We have all events from O3 ingested
  - Listening to O4 test alerts from IGWN
    - We are urging **any and all** teams who have configured their schedulers for O4 test alerts to incorporate pushing test pointings to the TM via the API



Gravitational Wave Events

Observing Run O4 Role Test

Type something in the input field to search the table for GW Event Names or Classifications:

Search..

Click on an alert name to see its visualization

Alert	Classification	Distance (Mpc)	# Pointings
MS230413e	BNS: (100.0%)	125.96 +/- 43.96	0
MS230413d	BNS: (100.0%)	168.89 +/- 46.81	0
MS230413c	BNS: (100.0%)	151.52 +/- 45.04	0
MS230413b	BNS: (100.0%)	108.98 +/- 29.86	0
MS230413a	BNS: (100.0%)	79.16 +/- 18.14	0
MS230412x	BNS: (100.0%)	93.64 +/- 23.71	0
MS230412w	BNS: (100.0%)	67.7 +/- 17.76	0
MS230412v	Retracted		0

GW Treasure Map: What's next for O4

- **Future Implementations**
  - Manage localized candidates for follow-up
    - API endpoint to GET candidate information
      - TNS, or User submission…
  - Other localized candidates
    - GRB/Neutrinos
      - Incorporate with coincident GW event
  - Scheduling suggestions
    - Provide observers with unobserved areas to tile/search with a given instrument footprint
- **Community feature suggestions**
  - We want to hear from our users as O4 is impending

GW Treasure Map

- **Main Takeaway:**
  - This utility is only as strong as its user base
- **Any Questions?**

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