Lasair: The Transient Alert Broker for LSST:UK

Matt Nicholl
Royal Astronomical Society Research Fellow
University of Edinburgh
Credit to...

The Lasair team:

Amanda Ibsen, Andy Lawrence, Dave Morris, Matt Nicholl, Stelios Voutsinas, Roy Williams

University of Edinburgh

Stephen Smartt, Ken Smith, David Young

Queens University Belfast

Lasair is currently a broker for the ZTF public alerts stream

We are building the infrastructure to scale up to LSST

- Edinburgh will host LSST UK Data Access Centre

(Lasair means ‘flash’ or ‘flame’ in Irish and Scots gaelic)
Lasair is being used (and not just in Edinburgh)

**SOAR telescope spectroscopic classification of optical transients**

ATel #12665; R. Cartier (CTIO), G. Terreran, R. Margutti (Northwestern University)

on 17 Apr 2019; 00:03 UT

Distributed as an Instant Email: Notice Supernovae

Credential Certification: Giacomo Terreran (giacomo.terreran@northwestern.edu)

Subjects: Optical, Supernovae

We report the following supernova classifications. The targets were supplied by the Zwicky Transient Facility (https://www.ztf.caltech.edu/; Kulkarni et al. 2018, ATel 11266) data stream processed through the Lasair broker (http://lasair.roe.ac.uk/), and by the All Sky Automated Survey for Supernovae ASAS-SN (see Shappee et al. 2014, ApJ, 788, 48 and...
What it does

Fetching public ZTF alerts via Kafka stream

Stores data in relational database(s)

• Candidates table: every alert

• Objects table: candidates grouped into transients (i.e. same ZTF name) with metadata

• ‘Rich’ information: e.g. crossmatches, comments

Provides user access in many forms…
Lasair is a broker for astronomers studying transient and variable astrophysical sources. It is being developed as a collaboration between the University of Edinburgh and Queen’s University, Belfast to build a broker service for alerts generated by the Large Synoptic Survey Telescope (LSST). We are planning to serve LSST transient alerts to the LSST user community and combine these data with value-added cross-matches against existing catalogues and analysis tools.

To help prototype the functionality needed to process alerts from LSST, Lasair is currently ingesting and presenting alerts from the public stream of the Zwicky Transient Facility (ZTF), which is releasing a transient alert stream in a format similar to that envisaged for LSST. We thank ZTF for access to this valuable public data stream. Lasair provides a broker system for users to access, visualise and extract science data. The capabilities of Lasair will develop incrementally, guided by user feedback, so please try it and tell us what more you need to do your science -- use the Contact link.

If you make use of this, please cite our paper: Lasair: The Transient Alert Broker for LSST:UK K. W. Smith, R. D. Williams et. al., Research Notes AAS, 3, 26 (2019). For more information about using this website, click About Lasair.

Acknowledgments
Lasair is supported by the UKRI Science and Technology Facilities Council and is a collaboration between the University of Edinburgh (grant ST/N002032/1) and Queen’s University Belfast (grant ST/N003502/1) within the LSST:UK Science Consortium. ZTF is supported by National Science Foundation grant AST-1440341 and a collaboration including Catalina, IPAC, the Weizmann Institute for Science, the Oskar Klein Centre at Stockholm University, the University of Maryland, the University of Washington, Deutsches Elektronen-Synchrotron and Humboldt University, Los Alamos National Laboratory, the TANGO Consortium of Taiwan, the University of Wisconsin at Milwaukee, and Lawrence Berkeley National Laboratory. Operations are conducted by CDD, IPAC, and UK. This research has made use of "A "Aldon sky atlas" developed at CGS, Strasbourg Observatory, France 2000AAS...338 and 2014ASP...465.277B."
Lasair is a broker for astronomers studying the Large Synoptic Survey Telescope (LSST) transient alerts to the LSST user community.

To help prototype the functionality needed for the Zwicky Transient Facility (ZTF), which is releasing its data stream. Lasair provides a broker system that is continually improved by user feedback, so please try it and tell us how we could improve.

If you make use of this, please cite our paper. For more information about using this website...

Acknowledgements
Lasair is supported by the UKRI Science and Technology Facilities Council. ZTF is supported by National Science Foundation Grant number AST-1536171
University of Wisconsin - Madison, California Institute of Technology, University of Maryland - College Park, Google, and TNO.
Cone Search

Enter RA and Dec and optionally radius in arcseconds, to search for objects in ZTF in that cone. They can be separated by spaces, commas, semicolons, or vertical bars. They can be in decimal degrees (floating point number), or sexagesimal in the form hh:mm:ss and dd:mm:ss or hh mm ss and dd mm ss. If the radius is not specified, it defaults to 5 arcsec. You can also enter an objectid, or a list of object id, each beginning with 'ZTF'.

Examples of searches:
- STF18coevw
- STF18coevw, STF18keysw, STF18aswhd
- 141.15725, 25.39398
- 141.15725, 25.39398, 5.0
- 09 24 37.74, +25 23 42.3
- 09 24 37.74, +25 23 42.3 5
- 09 24 37.74, +25 23 42.3 10.0
- 09 24 37.74, +25 23 42.3
- 09 24 37.74, +25 23 42.3 5

By object name
List of names
Coordinates:
Degrees
Sexagesimal
Cone radius
Very forgiving with formatting!
Cone Search

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[check this box for JSON output]

Run Cone Search

Examples of searches:
- STF1824sco1w
- STF1824sco1w, STF1824sco1w, STF1824sco1w
- 141.15725 -25.39508
- 141.15725 -25.39508 5.0
- 09h26m37.74 47.3 10.9
- 09 26 37.74 25 23 42.3
- 09 26 37.74 25 23 42.3 5
- 09 26 37.74 25 23 42.3 5
Cone Search

Enter RA and Dec and optionally radius in arcseconds, to search for objects in ZTF in that cone. They can be separated by spaces, commas, semicolons, or vertical bars. They can be in decimal degrees (floating point number), or sexagesimal in the form hh:mm:ss and dd:mm:ss or hh mm ss and dd mm ss. If the radius is not specified, it defaults to 5 arcsec. You can also enter an objectid, or a list of object Id, each beginning with 'ZTF'.

[check this box for JSON output] [ ]

Run Cone Search

RA,Dec, radius=272.61000, 43.75481, 180.0
3 objects found in cone
- ZTF19abgbey
- ZTF19aavijev
- ZTF18abrznyg

Examples of searches:
- ZTF18abgbey
- ZTF18aavijev, ZTF19abgbey, ZTF18abrznyg
- 141.157525, 25.39508
- 141.15725, 25.39508
- 141.15725, 25.39508, 5.0
- 09:24:37.74/-25:23:46.3
- 09:24:37.74/-25:23:46.2 10.0
- 09:24:37.74/-25:23:42.3 5
- 09:24:37.74/-25:23:42.3 5
- 09:24:37.74/-25:23:42.3 5
- 09:24:37.74/-25:23:42.3 5

Links to object pages
Object ZTF19abgcbev

- Object has 17 candidates, at mean position:
  - (RA, Dec) = (272.60118, 43.754824)
  - (l, b) = (71.010261, 25.450380)

- Classified as NT at distance 0.07 arcsec.

- The transient is synonymous with SDSS J181026.41+434517.3; an r=17.66 mag galaxy found in the SDSS DR12 PhotoObjAll Table catalogue. It's located 0.1 (0.1 Kpc) from the galaxy core. A host photoZ=0.080 (+0.026) implies a transient $M = -18.2$.

Information on this webpage also available as JSON.

Conesearch Links (at 5 arcsec): Simbad | NED | Transient Name Server | ZTF DR1

**Comments**

- In TNS as SN2019iks at 0.1 arcsec, discovered 2019-07-14 06:44:28 (MJD 58878.00) by ZTF

Machine-readable output

Sherlock classifications table (qub-sherlock.readthedocs.io)

Matches with star, galaxy, AGN and variable catalogs for contextual classification and z

Automated TNS checks

Comments table by user or code
### Crossmatches

<table>
<thead>
<tr>
<th>rank</th>
<th>ID</th>
<th>Catalog</th>
<th>Type</th>
<th>Separation</th>
<th>r-mag</th>
<th>g-mag</th>
<th>photoZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>123768681532441089</td>
<td>SDSS DR12 PhotoObjAll Table</td>
<td>galaxy</td>
<td>0.07</td>
<td>17.6617</td>
<td>18.3819</td>
<td>0.079843</td>
</tr>
</tbody>
</table>

### Sherlock crossmatches table: detailed info on nearest object(s)

- **Gaia**
- **2MASS**
- **SDSS DR12**
- **GSC**
- **Glade galaxies**
- **Downes CV**
- **Million quasars**
- **NED galaxies**
- **NED agn**

**Display field in AladinLite**

Optional catalog overlay

**Candidates** (To sort, click the column headings)

<table>
<thead>
<tr>
<th>MJD</th>
<th>UTC</th>
<th>Filter</th>
<th>magpsf</th>
<th>candidate</th>
<th>Image(target, ref, diff)</th>
</tr>
</thead>
<tbody>
<tr>
<td>58709.269</td>
<td>2019-08-14 06:26:54</td>
<td>r</td>
<td>18.901 ± 0.119</td>
<td><em>t</em></td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>58709.157</td>
<td>2019-08-14 03:45:55</td>
<td>g</td>
<td>19.773 ± 0.231</td>
<td><img src="image2.png" alt="Image" /></td>
<td></td>
</tr>
<tr>
<td>58706.182</td>
<td>2019-08-11 04:22:30</td>
<td>g</td>
<td>19.473 ± 0.185</td>
<td><em>t</em></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Links for more info...

All candidates associated with object

[Link for more info...](https://example.com)
**Candidate object**

This candidate is part of object ZTF19abqcbey.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>jd</td>
<td>2458706.6823032</td>
</tr>
<tr>
<td>ra</td>
<td>272.6101299</td>
</tr>
<tr>
<td>dec</td>
<td>43.7548165</td>
</tr>
<tr>
<td>magpsf</td>
<td>19.4731</td>
</tr>
<tr>
<td>sigmapsf</td>
<td>0.185262</td>
</tr>
<tr>
<td>magnr</td>
<td>19.232</td>
</tr>
<tr>
<td>sigmagnr</td>
<td>0.073</td>
</tr>
<tr>
<td>magzpsci</td>
<td>26.1701</td>
</tr>
<tr>
<td>isdiffpos</td>
<td>t</td>
</tr>
<tr>
<td>nid</td>
<td>952</td>
</tr>
<tr>
<td>field</td>
<td>725</td>
</tr>
<tr>
<td>xpos</td>
<td>2792.67</td>
</tr>
<tr>
<td>ypos</td>
<td>1713.28</td>
</tr>
</tbody>
</table>

Contains all info from ZTF alerts
Candidate object

This candidate is part of object ZTF19a

<table>
<thead>
<tr>
<th>jd</th>
<th>ra</th>
<th>dec</th>
<th>magpsf</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Filters: produce sub-stream satisfying some criteria
=> run automatically on newly ingested data (i.e. real-time)
Queries: search database for events satisfying criteria
=> run at any time by user on all current and historical events

“Every filter is a query, but not every query is a filter” - Roy Williams
### Lasair Filters

The following is a small selection of event filters that Lasair can produce.

*The following may take up to a minute to execute. Please be patient.*

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN-like candidates in last 14 days</td>
<td>SN-like candidates (Sherlock classifications SN, NT and orphans). Rejects Pan-STARRS star matches</td>
</tr>
<tr>
<td>All nuclear transients and TDE candidates</td>
<td>Near core of inactive catalogued galaxies (within 1°), flags Pan-STARRS stellar matches to let user judge star/galaxy separation. Objects discovered in last 30 days.</td>
</tr>
<tr>
<td>TNS crossmatch</td>
<td>This query finds all Lasair objects that are in the Transient Name Server, meaning they have a comment that includes the string 'TNS'. The most recent are first.</td>
</tr>
</tbody>
</table>

### Lasair Filters and Queries

Lasair also provides a more powerful freeform SQL interface where you can see the SQL for these streams, customise for yourself, make and save your own filters.

Click Here to Build Your Own Filter

---

**The lazy option: default filters**

**Advanced option: build your own**
Filter the ZTF object database

The form below is a builder for SQL SELECT queries on the ZTF database of objects. There are three tables that can be joined in SELECT queries (only SELECT queries are allowed). See examples below. The tables are:

- **objects**: The astrophysical objects which consist of a series of candidates (aka detections). The object has a light curve, the candidate has a single magnitude and date.
- **sherlock_crossmatches**: Information about each object derived from multiple catalogs by the Sherlock software. The crossmatches have a rank 1, 2, 3... where 1 is considered most likely.
- **candidates**: The individual detections provided by ZTF each night. Each is associated with an object, which is a cluster of detections within 1.5 arcsec, and presumed to be an astrophysical object.

For detailed information about the attributes of these three tables, that you can use in the filters: [click here](#).

- The public survey uses two filters: fid=1 (g) and fid=2 (r)
- For each observing field of the survey and each of the g and r filters, ZTF will only issue candidate alerts when it has built up a reference image of that field with that filter, by stacking 15 good images.
- Once that is in place, each fresh image is subtracted from the reference, and any 5-sigma difference generates a candidate alert.
- When a candidate is within 1.5 arcseconds of a previous candidate, it gets the same objectID. Thus a light curve can be obtained from all the candidates that have a given objectID.
- More details of the processing pipeline are available [here](#).
- Further cuts can be made to remove spurious candidates. The highest quality candidates satisfy the criterion: candidates.ZB >= 0.65 and candidates.Nbad = 0 and candidates.FWHM <= 5 and candidates.eLong <= 1.2 and abs(candidates.magDiff) <= 0.1. See example below.

If you would like to learn the SQL language, [this](#) is a good resource.

**SELECT**

**FROM JOIN OF**

- candidates
- noncandidates
- objects
- sherlock_classifications
- sherlock_crossmatches

List of attributes that you can query on
Available tables Checklist loads tables *in advance* for real-time filters

---

Contributed Stored Filters

Stored filters created and made public are listed below. Click on the name of the filter to push it into the area above.

<table>
<thead>
<tr>
<th>Name</th>
<th>Owner</th>
<th>Description</th>
<th>Query</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN-like candidates in last 14 days</td>
<td>Stephen Smartt</td>
<td>SN-like candidates (Sherlock classifications SN, NT and orphans). Rejects Pan-STARRS star matches</td>
<td></td>
</tr>
</tbody>
</table>

Clicking on a stored query populates the form

Free text (SQL)
Only return events with candidates in last X days

Go!

Contributed Stored Filters

<table>
<thead>
<tr>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>SN-like candidates in last 14 days</td>
<td>Stephen Smartt</td>
<td>SN-like candidates (Sherlock classifications SN, NT and orphans). Rejects Pan-STARRS star matches</td>
<td>SELECT objects.objectId, objects.ramean, objects.decmean, objects.mjmin - 2400000.5 AS mjmin, FROM JOIN OF candidates objects, sherlock_classifications WHERE sherlock_classifications.classification NOT IN (&quot;VS&quot;, &quot;AGN&quot;, &quot;CV&quot;, &quot;BS&quot;) AND objects.mjmin &gt; JDNOW() - 14 AND objects.ncand &gt; 3 AND candidates.objectId = objects.objectId AND include only recent events (10 days) OR objects.mjmax - 2400000.5 AS mjmax, objects.magmin, latestmap, sherlock_classifications.classification, IF(disp1 &lt; 2 AND candidates.cscore1 &gt; 0.49, &quot;Within 2arcsec of PS1 star&quot;, &quot;Not Near PS1 star&quot;) score</td>
</tr>
</tbody>
</table>
SELECT /* MAX_EXECUTION_TIME(300000) */ objects.objectId, objects.ra mean, objects.dec mean, objects.jd min - 2400000.5 AS mjmin, objects.jd max - 2400000.5 AS mjmax, objects.mag min, latest mag, sherlock_classifications.classification, If(dist np r1 < 2 AND candidates.gs score > 0.49, "Within 2 arcsec of PS1 star", "Not Near PS1 star") score FROM objects, candidates, sherlock_classifications, WHERE objects.objectId = candidates.objectId AND objects.primaryId = sherlock_classifications.transient_object_id AND objects.jd max > JD N OW() - 10.0000 AND candidates.jd > JD NOW() - 10.0000 AND sherlock_classifications.classification NOT IN ("VS", "AGN", "CV", "BS") AND objects.jd min > JD N OW() - 14 AND objects.n cand > 3 AND candidates.objectId = objects.objectId AND (candidates.jd > JD NOW() - 14) AND candidates.mag psf < 20 AND candidates.rb >= 0.75 AND candidates.n bad = 0 AND candidates.is diff pos = "t" AND candidates.fwhm <= 5 AND ABS(candidates.mag diff) <= 0.1 AND candidates.el ong <= 1.2 ORDER BY score, mjmin DESC LIMIT 1000 OFFSET 0

<table>
<thead>
<tr>
<th>objectid</th>
<th>ramean</th>
<th>decmean</th>
<th>mjmin</th>
<th>mjmax</th>
<th>magmin</th>
<th>latest mag</th>
<th>classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZTF19abplzzk</td>
<td>305.8292512666667</td>
<td>66.31872823333334</td>
<td>58708.2114580007</td>
<td>58710.21499999985</td>
<td>18.5624</td>
<td>18.7438</td>
<td>ORPHA</td>
</tr>
<tr>
<td>ZTF19abpljeyk</td>
<td>354.72404789999996</td>
<td>5.610869725</td>
<td>58707.435277800076</td>
<td>58707.47921299981</td>
<td>19.2637</td>
<td>19.2637</td>
<td>ORPHA</td>
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<td>19.2637</td>
<td>19.2637</td>
<td>ORPHA</td>
</tr>
<tr>
<td>ZTF19abpecvt</td>
<td>15.7024001</td>
<td>2.0186318</td>
<td>58706.4016719988</td>
<td>58706.419421299826</td>
<td>18.4728</td>
<td>18.4989</td>
<td>ORPHA</td>
</tr>
</tbody>
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| **SN-like candidates in last 14 days** | Stephen Smartt | SN-like candidates (Sherlock classifications SN, NT and orphans). Rejects Pan-STARRS star matches | ```

```
Filter the ZTF object database

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For detailed information about the attributes of these three tables, that you can use in the filters: click here.

- The public survey uses two filters: fid=1 (g) and fid=2 (r)
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- More details of the processing pipeline are available here.
- Further cuts can be made to remove spurious candidates. The highest quality candidates satisfy the criterion candidates.rb >= 0.65 and candidates.nbad = 0 and candidates.fwhm <= 5 and candidates.elong <= 1.2 and abs(candidates.magdiff) <= 0.1. See example below.
- If you would like to learn the SQL language, this is a good resource.
Sign up

First name and Last name
Preferred username
Your email

After you sign up, you will enter your email again, and respond to that email.

Sign up
Filter the ZTF object database

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- If you would like to learn the SQL language, this is a good resource.
### My Stored Queries

Stored filters that you control are listed below. Click on the name of the filter to push it into the filter area above, or the link below the name to edit it. Click to edit

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Query</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SLSNe</strong></td>
<td>Supernovae more than 1.5 mags brighter than host galaxy</td>
<td><code>DISTINCT objects.objectId, objects.latestmag, candidates.smag1</code>&lt;br&gt;<code>candidates, objects, sherlock_classifications</code>&lt;br&gt;<code>objects.jmin &gt; 2658659.5 AND objects.ncnd = 2 AND objects.sherlock_classification NOT IN (&quot;YS&quot;, &quot;AGN&quot;, &quot;CV&quot;, &quot;BS&quot;) AND candidates.distpser1 &lt; 0.5 AND candidates.sgscore1 &lt; 0.5</code>&lt;br&gt;<code>ORDER BY objects.ncnd DESC</code></td>
</tr>
<tr>
<td><strong>C-SNAILS</strong></td>
<td>Classification Survey for Nuclear transients with Liverpool and Lasair</td>
<td><code>DISTINCT objects.objectId, objects.latestmag as g, objects.magnm as g_mag, candidates.smag1 as g_host, objects.chelexmag as r, objects.magnm as r_mag, candidates.smag1 as r_host</code>&lt;br&gt;<code>candidates, objects</code>&lt;br&gt;<code>objects.jmin &gt; 2658659.5 AND objects.ncnd = 2 AND objects.sherlock_classification NOT IN (&quot;YS&quot;, &quot;AGN&quot;, &quot;CV&quot;, &quot;BS&quot;) AND candidates.distpser1 &lt; 0.5 AND candidates.sgscore1 &lt; 0.5</code></td>
</tr>
</tbody>
</table>

**Contributed Stored Filters**

Stored filters created and made public are listed below. Click on the name of the filter to push it into the area above.
Run automatically on incoming data stream
=> query becomes a filter

Click here to see substream

Allow other users to see/run as query

Matt Nicholl
RAS Fellow
University of Edinburgh
Returns substream as JSON
Populated each day
(only been running for one day!)

URL = lasair.roe.ac.uk/static/ztf/streams/<STREAM_NAME>
SLSNe

Supernovae more than 1.5 mags brighter than host galaxy

Active: ☑ (Topic name is SLSNe)
Public: ☐

SELECT

DISTINCT
  objects.objectId,
  objects.latestRmag,
  candidates.srmag1

FROM JOIN OF

☑ candidates  ☐ objects  ☐ sherlock_classifications
☐ noncandidates  ☑ objects  ☐ sherlock_crossmatches

WHERE ORDER

sherlock_classifications.classification NOT IN ("VS", "AGN", "CV", "BS")
  AND objects.ncand > 1
  AND objects.magmax+1.5 < candidates.srmag1
  AND candidates.aggcore1 < 0.5

Update query

Delete this query
Watchlists will be soon be combined with filters: e.g. alert when source brightens by >X mag

public watchlists

name | owner | description | radius | active
---|---|---|---|---
cataclysmic variables | roy williams | catalog of cataclysmic variables (downes+ 2001-2006) vizier v123a | 0.2 arcsec | |
bl lac for tev | roy williams | bl lac candidates for tev observations (massaro+, 2013) | 1.0 arcsec | |
am cvn | roy williams | these are 56 very close binaries of compact objects, from "the physical properties of am cvn stars: new insights from gaia dr2", ramsay et al 2018 a&a 620a 141 | 1.0 arcsec | |
am her | gavin ramsay | magnetic cvs (b>10mg). some go into prolonged low states. see cropper 1990 ssrv 54 195. objects marked with an asterisk indicate its eclipsing and 'a' indicates asynchronous | 5.0 arcsec | √
### Cataclysmic Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Catalog of Cataclysmic Variables (Downes+ 2001-2006) Vizier V/123A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radius (arcsec)</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Active</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>Public</td>
<td>yes</td>
</tr>
</tbody>
</table>

Watchlist has 1830 sources under watch.

'Active' and 'public' similar to filters
Login to make your own

**Input**

<table>
<thead>
<tr>
<th>Object</th>
<th>RA</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1390Cyg_GR177</td>
<td>307.0971667</td>
<td>39.0653611</td>
</tr>
<tr>
<td>V516Cyg_S4530</td>
<td>311.79075</td>
<td>49.942047</td>
</tr>
<tr>
<td>Her_SDSSJ163605+465205</td>
<td>249.020875</td>
<td>46.867912</td>
</tr>
<tr>
<td>Cyg1_NV25181</td>
<td>308.6604683</td>
<td>50.8016368</td>
</tr>
<tr>
<td>Dra_SDSSJ132723+652854</td>
<td>201.847179</td>
<td>65.4817738</td>
</tr>
<tr>
<td>V513Cas_MacCv4</td>
<td>4.5620833</td>
<td>66.30375</td>
</tr>
<tr>
<td>V5104Cyg_SYSV710</td>
<td>292.2352083</td>
<td>43.0936945</td>
</tr>
<tr>
<td>FTCam_AntipinV64</td>
<td>50.3096875</td>
<td>61.09075</td>
</tr>
<tr>
<td>Her_</td>
<td>267.0242917</td>
<td>34.6670833</td>
</tr>
<tr>
<td>And_SDSSJ001856+345444</td>
<td>4.7372083</td>
<td>34.9123056</td>
</tr>
<tr>
<td>Her_SDSSJ163539+201106</td>
<td>253.4960802</td>
<td>20.1695722</td>
</tr>
<tr>
<td>RULMi_CBS-119/Ton1143</td>
<td>150.531073</td>
<td>33.8500855</td>
</tr>
<tr>
<td>EG1ac_S4617</td>
<td>342.6620833</td>
<td>55.2477725</td>
</tr>
<tr>
<td>FLYPer_6401936</td>
<td>70.4859533</td>
<td>50.71</td>
</tr>
<tr>
<td>B1Or1_1196</td>
<td>80.9657083</td>
<td>1.0085556</td>
</tr>
<tr>
<td>Peg_AntipinV79</td>
<td>328.6408363</td>
<td></td>
</tr>
<tr>
<td>Peg_SDSSJ214354+142458</td>
<td>325.9774899</td>
<td>12.7478938</td>
</tr>
<tr>
<td>IMon_931933</td>
<td>107.6905683</td>
<td>0.6852578</td>
</tr>
<tr>
<td>ABDra_901934</td>
<td>297.77215</td>
<td>77.7396945</td>
</tr>
</tbody>
</table>

**Output**

<table>
<thead>
<tr>
<th>objectid</th>
<th>candidates</th>
<th>mag range</th>
<th>Sherlock class</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZTF18aawbji</td>
<td>277</td>
<td>3.1</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18aazxhdb</td>
<td>245</td>
<td>3.6</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18aagtesn</td>
<td>241</td>
<td>3.0</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18aadzll</td>
<td>218</td>
<td>2.5</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18aaieivs</td>
<td>200</td>
<td>2.3</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18abbrvtf</td>
<td>185</td>
<td>2.7</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18abjtwlb</td>
<td>134</td>
<td>5.5</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18abdmty</td>
<td>127</td>
<td>3.5</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18aajrzvj</td>
<td>119</td>
<td>2.1</td>
<td>AGN</td>
</tr>
<tr>
<td>ZTF17aahaqht</td>
<td>115</td>
<td>2.0</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18aabvknz</td>
<td>106</td>
<td>3.2</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF17aadmyg</td>
<td>97</td>
<td>3.9</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18abwmu</td>
<td>96</td>
<td>2.1</td>
<td>CV</td>
</tr>
<tr>
<td>ZTF18aabwqny</td>
<td>87</td>
<td>3.5</td>
<td>CV</td>
</tr>
<tr>
<td>Description</td>
<td>Catalog of Cataclysmic variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radius</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Watchlist has 1830 sources under watch.

**Watchlist**

<table>
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<th>Object</th>
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</tr>
<tr>
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<td>311.705</td>
</tr>
<tr>
<td>Her_SDSSJ163605+465205</td>
<td>249.12</td>
</tr>
<tr>
<td>Cyg1_NSV25181</td>
<td>308.12</td>
</tr>
<tr>
<td>Dra_SDSSJ132723+652854</td>
<td>201.12</td>
</tr>
</tbody>
</table>
Gravitational Wave Skymaps

The following LIGO-Virgo skymaps have been released, and are available here as fits files. Each is encoded by the event date as GWyyymmdd. For latest information, see also GraceDB.

- GW151226
- GW170818
- GW151012
- GW170817
- GW170104
- GW170823
- GW170608
- GW170814
- GW170809
- GW170729
- S190408an
- GW150914
- S190412m
- S190405ar
- S190421ar
- S190425z
- S190426c
- S190503bf
- S190510g
- S190510g_1
- S190510g_2
- S190512at
- S190513bm
- S190513bm_1
- S190517h
- S190512at_1
- S190518bb
- S190518bj
- S190521g
- S190521g_1
- S190532a_1
Handy summary:
- Marginalised distance
- Alert time
- Source type probabilities
- Position of highest probability density
Toggle on/off:

- ZTF coverage of field (currently nothing public following a GW alert)
- ZTF candidates (same)
- GLADE galaxies
Zoom in to see galaxies
Area of square proportional to probability
Zoom in to see galaxies
Area of square proportional to probability

200 most probable galaxies are listed

Click on name or yellow square for galaxy info from NED
9 contour lines show percentiles of the probability of the position:

- Coverage: shows if the ZTF survey has coverage.
- Candidates: Shows the ZTF candidates surveys.
- Galaxies: Shows galaxies that may have the event.

Remember to click "submit" to refresh the page.

<table>
<thead>
<tr>
<th>Distance</th>
<th>267.4 ± 51.6 Mpc</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO Date:</td>
<td>2019-08-14T21:10</td>
</tr>
<tr>
<td>Julian date:</td>
<td>2458710.382</td>
</tr>
<tr>
<td>Percent probability:</td>
<td>BNS=0.0, NSBH=0.0</td>
</tr>
<tr>
<td>max prob RA,Dec</td>
<td>12.8, -25.2</td>
</tr>
</tbody>
</table>
Pro-level users:
Login* to our Jupyter service and access the database with Python
Do your analysis within Lasair and output only the results!

*this is a separate, more restricted account
(but if you’re a real astronomer, you will be approved)
Once approved for Jupyter access, sign up via: aai.egi.eu
Choose your academic/social account

Northwestern University

Or if you can’t find your institution, can use social account

Can’t find your identity provider?
Specify memory needed

Start session
Built-in modelling!
A ZTF transient you like (or the result of some query)

Specify model, and redshift if possible

Fixed params to speed up fit

Available models

Simple API to get object page in JSON:
https://lasair.roe.ac.uk/object/ZTF19…/json/
These cells convert to Open Supernova Catalog format for MOSFiT.
# Check for classification and redshift in TNS

tns_url = "https://wis-tns.weizmann.ac.il/api/get/
with open('tns-api-key.txt', 'r') as f:
    api_key = f.read()

search_obj = OrderedDict(["ra", data['objectData']['ra_mean']],
"dec", data['objectData']['dec_mean'],
"radius", 2.5), "units", "arcsec", "objname", "", 
"internal_name", "])")

search_url = tns_url+"search"search_data = (["api_key", (None, api_key)], ('data',(None, json.dumps(search_obj))])

r = requests.post(search_url, files=search_data)
# If transient is known, will have an IAU name (AT/ST 20XXy), add such names to our objects
if r.json()['data']["reply"]["transient"]:
    iau_name = r.json()['data']["reply"][0]["objname"]
newdict[transient]["alias"].append( {"value": iau_name, "source": "3" })

# Now check if object has a classification attached
# Always will for 'SN' names, but could also happen for 'AT', e.g. if TDE rather than SN
get_obj = OrderedDict(["objname", iau_name], ("photometry", "0"), ("spectra", "0")])
get_url = tns_url+"object"get_data = (["api_key", (None, api_key)], ('data',(None, json.dumps(get_obj))])

r2 = requests.post(get_url, files=get_data)
# If classified, add type to dictionary
if r2.json()['data']["reply"]["object_type"]["name"]:  
    print(r2.json()['data']["reply"]["object_type"]["name"]
    newdict[transient]["classification"] = [ 
        ("value": r2.json()['data']["reply"]["object_type"]["name"],
        "source": "3" )
    ]

    print(r2.json()['data']["reply"]["redshift"]
newdict[transient]["redshift"] = [ 
    ("value": str(r2.json()['data']["reply"]["redshift"])),
    "source": "3" ]
}  
else:
    newdict[transient]["redshift"] = [ 
    ("value": str(redshift)),
    "source": "2"
}

SLSN-II 0.1173

Check in TNS, get type and more accurate redshift
Save formatted data

Initiate quick run of MOSFiT using only local data and no interactive prompts

(Plotting stuff)
Success!

And only took 5 minutes for OK solution
C-SNAILS: Classification Survey for Nuclear Transients with Liverpool and LaSair
In [1]:

# List objects in queue here

in_queue = ['ZTF19abmmnxz', 'ZTF19abocled', 'ZTF19abpangr']

# Classifications so far:

classified = {}

classified['ZTF19abclykm'] = {'class': 'SLSN II n z=0.092 (LT)'}
classified['ZTF19abucdao'] = {'class': 'AGN z=0.22 (LT)'}
classified['ZTF19abgcey'] = {'class': 'SN Ia? z=0.056 (LT)'}
classified['ZTF19abgcnul'] = {'class': 'CV (LT)'}
classified['ZTF19abfpylo'] = {'class': 'SN Ia? z=0.1 (LT)'}
classified['ZTF19abidbya'] = {'class': 'Blue continuum (LT)'}
classified['ZTF19abgjlef'] = {'class': 'SN Ia z=0.058 (LT)'}
classified['ZTF19abmsk'] = {'class': 'Blue continuum z=0.0788 (LT)'}
classified['ZTF19abhhyc'] = {'class': 'Blue continuum z=0.1525 (LT)'}
classified['ZTF19abdkgvey'] = {'class': 'Unclear, broad features, needs better reduction (LT)'}
classified['ZTF19abldfnb'] = {'class': 'Blue continuum z=0.076 (LT)'}
classified['ZTF19abjiole'] = {'class': 'Blue continuum, broad(?). Ha, z=0.087 (LT)'}
classified['ZTF19abjypsa'] = {'class': 'Observed, data not yet processed'}
classified['ZTF19abjpsb'] = {'class': 'SN Ic z=0.056 (LT)'}
classified['ZTF19abkfxfxb'] = {'class': 'SN II z=0.032 (LT)'}

In [2]:

import mysql.connector
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
import requests
import json
from collections import OrderedDict
import wget
import matplotlib.image as mpimg
import os
from astropy.table import Table
import time
from astropy.io import ascii
from datetime import date
import glob
import smtplib

# connect to database (from Roy's code)
import settings

sql = mysql.connector.connect(
    user = settings.USER, 
...
Early results

1 superluminous supernova IIin

2 good TDE candidates
Next steps...

Experimenting with new technologies for faster DB access

Scalability for LSST

More cross-matching, e.g. importing PS1 catalog to Sherlock

Automated alerts (already exist for GW) based on filters and watchlists

Machine learning light curve classification (RAPID - see Daniel Muthukrishna’s talk)

Tell me what you want from Lasair and we’ll help you do it!