

# Lasair: a ZTF broker and prototype LSST broker



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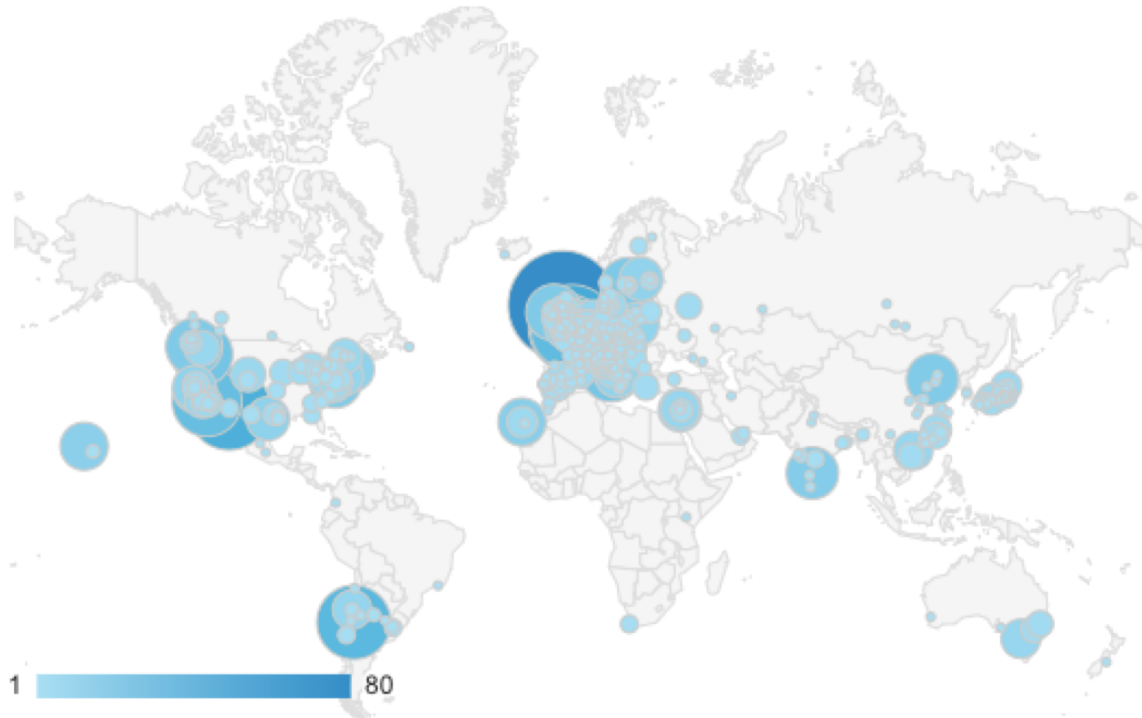
*Queens University Belfast*

# Lasair is being used

## FDST spectroscopic classification of SN 2019dwp

ATel #12740; *C. Frohmaier (University of Portsmouth - ICG), H. Kuncarayakti (University of*

The Fast and Dark Side of Transients experiment (FDST; ATel #12362) reports the spectroscopic observation of SN 2019dwp. The target was supplied by the Zwicky Transient Facility (<https://www.ztf.caltech.edu/>; Kulkarni et al. 2018, ATel 11266) and processed through the Lasair broker ([Smith, Williams, et al. 2019, RNAAS, 3, 26](https://lasair.roe.ac.uk/); <https://lasair.roe.ac.uk/>). Classifications were done with SNID (Blondin & Tonry, 2007, ApJ, 666, 1024).



<https://lasair.roe.ac.uk>

City ?	Users ? ↓	New Users ?
	1,702 % of Total: 100.00% (1,702)	1,601 % of Total: 100.06% (1,600)
	124 (6.07%)	104 (6.50%)
2. Edinburgh	80 (3.92%)	63 (3.94%)
3. London	52 (2.55%)	27 (1.69%)
4. Tucson	45 (2.20%)	41 (2.56%)
5. Santiago	39 (1.91%)	30 (1.87%)
6. Southampton	36 (1.76%)	29 (1.81%)
7. Pasadena	33 (1.62%)	30 (1.87%)
8. Boardman	27 (1.32%)	27 (1.69%)
9. Rome	25 (1.22%)	23 (1.44%)
10. Padua	22 (1.08%)	19 (1.19%)

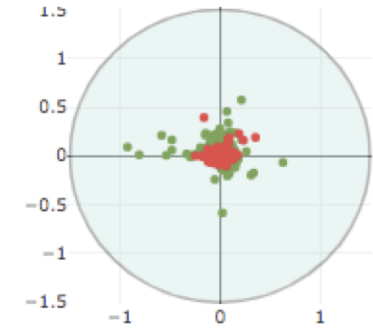
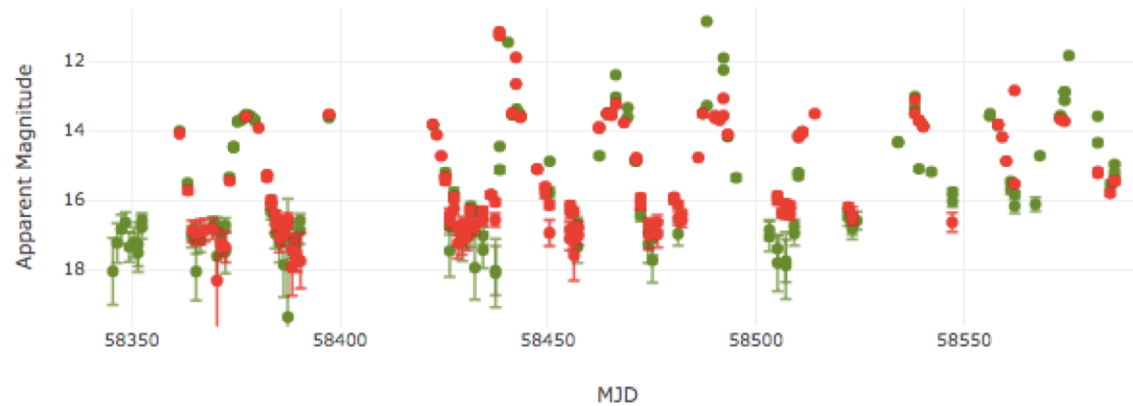


- ZTF broker driven by Kafka
  - Fetching public ZTF since May 2018
  - 33 million detections as 1.5 million objects
- Part of wider effort: LSST:UK Data Access Centre
  - A service to astronomers, a platform for ideas
- Public website (optional free signup);
  - Jupyter aspect (ask me about access);
- Freeform SQL interface
  - Stored queries -- can be public or private

- Users can make "watchlists"
  - Collection of interesting sources
  - Which ZTF objects coincident with watched sources
- Rich object page
  - Lightcurves, non-detections, Context, AladinLite/PanStarrs, detection images, comments
- Crossmatch with many common catalogs
  - "Sherlock" code: SDSS, 2MASS, etc etc
  - Transient Name Server (TNS) match
- All pages have JSON output option

## Object Page

### Object ZTF17aaaslud



● Difference Magnitude | ● Apparent Magnitude (see [note](#))

- Object has 301 candidates, at mean position:
  - (RA, Dec) = (62.145777, 51.246695)
  - (RA, Dec) = (04:08:34.987, 51:14:48.100)
  - (l, b) = (151.257740, -0.446324)
- NOTE: There are 207 of 301 candidates (below) where the detected brightness is less than the reference brightness (where the magnitude is followed by "f"), also indicated by an open circle in the light curve above.
- Classified as CV at distance 0.05 arcsec.
- 
- The transient is synonymous with *FOPer/250700848842152320/04083*; a V=16.55 mag CV found in the RITTER/GAIA/2MASS/SDSS/GAIA catalogues. It's located 0.1 from the CV core.
- Information on this webpage also [available as JSON](#).
- Conesearch Links (at 5 arcsec): | [Simbad](#) | [NED](#) | [Transient Name Server](#) | [ZTF DR1](#)

# Object Page

## Crossmatches

rank	ID	Catalog
1	FOPer/250700848842152320/04083	RITTER/GAIA/2MASS/SDSS/GSC/DOWNES

## AladinLite

Image layer is PanSTARRS DR1; use the layers icon to change it ( ). You can also overlay PanST

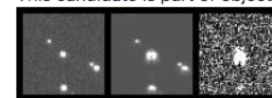


## Candidates (To sort, click the column headings)

MJD	UTC	Filter	magpsf	candidate	Image(target, ref, diff)
58586.163	2019-04-13 03:54:41	g	15.034 ± 0.043	f <a href="#">832162985615010007</a>	
58586.163	2019-04-13 03:54:02	g	14.404 ± 0.024	f <a href="#">832162530715010018</a>	
58586.144	2019-04-13 03:26:42	r	15.046 ± 0.030	f <a href="#">832143555615010008</a>	
58586.143	2019-04-13 03:26:04	r	14.745 ± 0.033	f <a href="#">832143100715010025</a>	
58585.175	2019-04-12 04:12:05	g	14.831 ± 0.029	f <a href="#">831175055615010007</a>	

## Candidate object

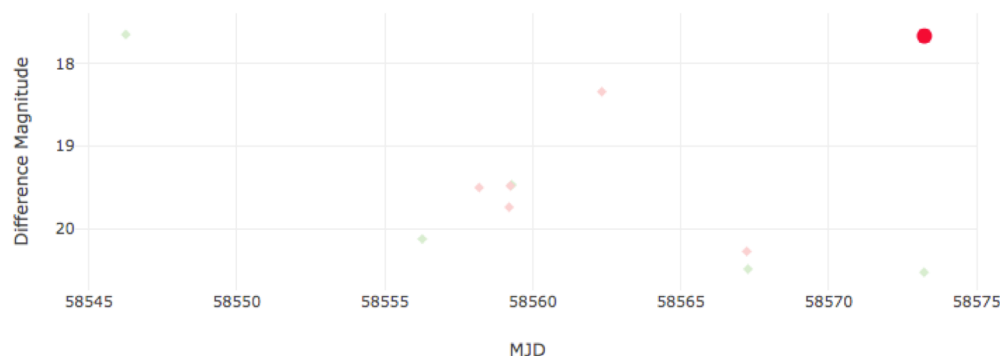
This candidate is part of object [ZTF17aaaslud](#).



jd	2458586.6629861
ra	62.145735
dec	51.2467269
magpsf	15.0338
sigmapsf	0.0432644
magnr	14.705
sigmagnr	0.034
magzpsci	25.9958
isdiffpos	f
nid	832
field	742
xpos	402.685
ypos	836.959

# Solar System Object

## Object ZTF19aanweup



● Difference Magnitude | ● Apparent Magnitude (see note)

- Object has 1 candidates, at mean position:
  - (RA, Dec) = (150.291946, 0.855007)
  - (RA, Dec) = (10:01:10.067, 00:51:18.024)
- Moving object, MPC name is **6478**
- Information on this webpage also available as [JSON](#).
- Conesearch Links (at 5 arcsec): | [Simbad](#) | [NED](#) | [Transient Name Server](#)

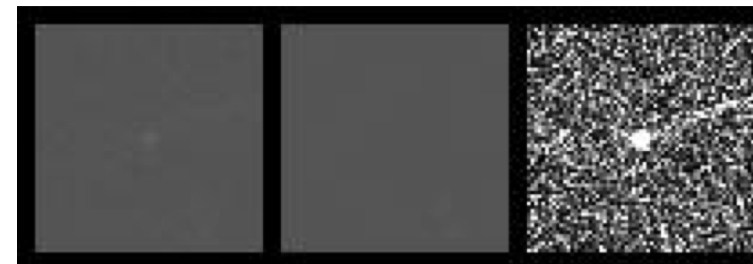
### Comments

You must be signed in to post comments.

**6478 Gault (1988 JC1)**  
 Classification: Main-belt Asteroid SPK-ID: 2006478  
 [ Ephemeris | Orbit Diagram | Orbital Elements | Mission Design | Physical Parameters | Discovery Circumstances ]  
 [ show orbit diagram ]

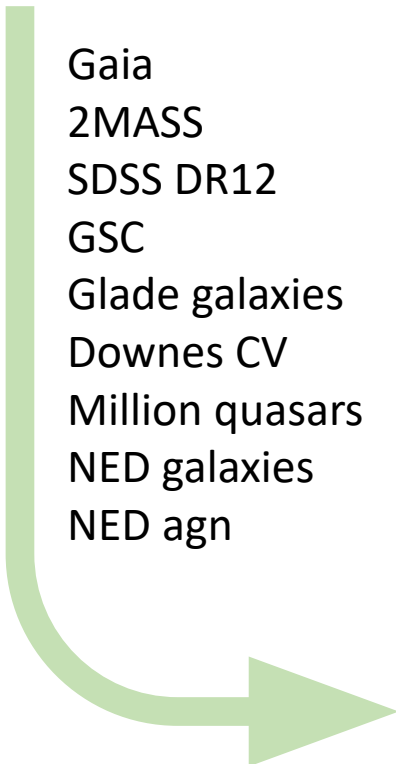
Orbital Elements at Epoch 2458600.5 (2019-Apr-27.0) TDB			
Reference: <a href="#">JPL 21</a> (heliocentric ecliptic J2000)			
Element	Value	Uncertainty (1-sigma)	Units
e	.1935872040203809	4.2459e-08	
a	2.305145037731484	9.2758e-09	au
q	1.858898455015591	9.9111e-08	au
i	22.81133582510465	4.9836e-06	deg

Orbit Determination Parameters	
# obs. used (total)	1060
data-arc span	10792 days (29.55 yr)
first obs. used	1988-05-12
last obs. used	2017-11-28
planetary ephem.	DE431
SB-pert. ephem.	SB431-N16

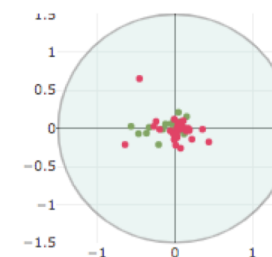
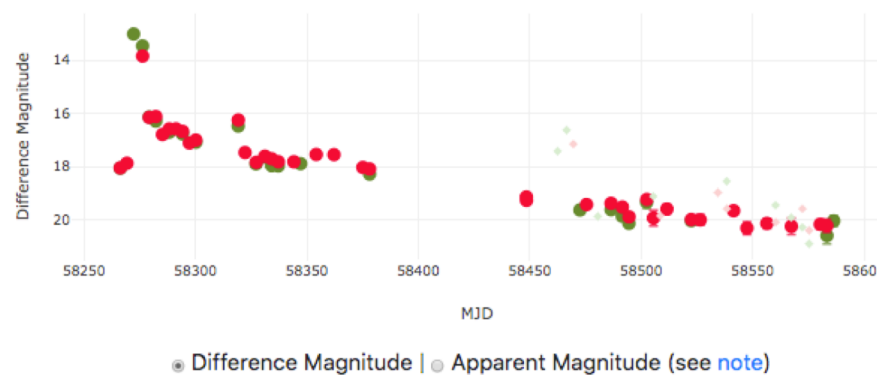


# Sherlock

- A python package with command-line tools for contextually classifying variable/transient astronomical sources.
- <https://pypi.org/project/qub-sherlock/>



## Object ZTF18aautxxk



- Classified as CV at distance 0.13 arcsec.
- The transient is synonymous with [1237661957761269768/8826/J1411](#); a V=19.39 mag galaxy found in the SDSS/DOWNES/RITTER/GAIA/GSC catalogues. It's located 0.1 (0.3 Kpc) from the galaxy core. A host z=0.135 implies a transient  $M = -20.74$ .
- Information on this webpage also [available as JSON](#).
- Conesearch Links (at 5 arcsec): | [Simbad](#) | [NED](#) | [Transient Name Server](#)

### Crossmatches

rank	ID	Catalog	Type	Separation	r-mag	g-mag	photoZ
1	1237661957761269768/8826/J1411	SDSS/DOWNES/RITTER/GAIA/GSC	galaxy	0.13	19.5933	19.3947	None



## Canned queries

for those who don't like SQL

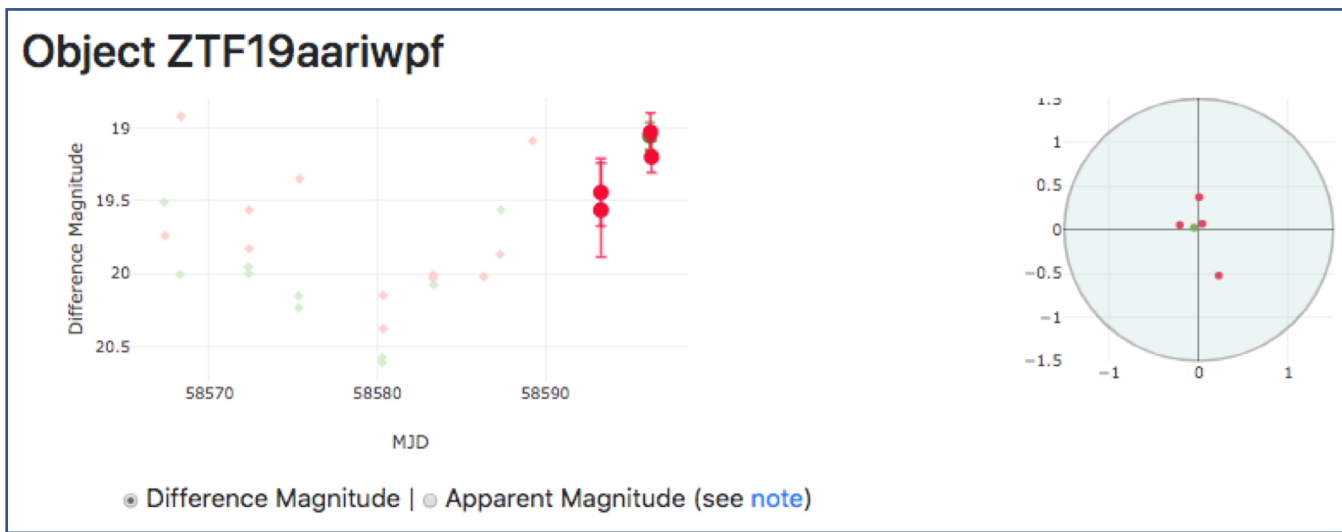
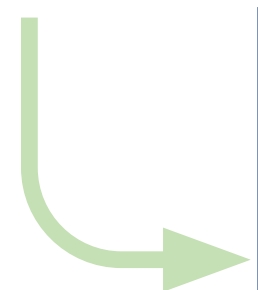
- Example:
  - Supernova candidates

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### Lasair Streams

The following is a small selection of streams that Lasair can produce.  
*The following queries may take up to a minute to execute. Please be patient.*

Name	Description
<b>SN-like candidates in last 14 days</b>	SN-like candidates (Sherlock classifications SN, NT and orphans), time limit adjustable (just adjust the number 14). Rejects Pan-STARRS star matches



# Run your own SQL query

## Your own saved queries + Public queries from others

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Jupyter  
Ingestion Status  
Release Notes  
Team & Contact

### Lasair Streams

The following is a small selection of streams t  
*The following queries may take up to a mir.*

Name	Description
<a href="#">SN-like candidates in last 14 days</a>	SN-like candidates (adjust the number 1-
<a href="#">All nuclear transients and TDE candidates</a>	Near core of inactive user judge star/gala:
<a href="#">TNS crossmatch</a>	This query finds all L comment that includ

### Lasair Queries

Lasair also provides a more powerful freeform own queries.

[Click Here to Build Your Own Query](#)

<b>An Asteroid's Tail</b>	Ken Smith	Check ZTF detections for active asteroid (6478) Gault
---------------------------	-----------	---

**Submit Query** (check this box for JSON output )

```
SELECT objectId, jd-2400000.5 as mjd, ssnamenr
FROM candidates WHERE
ssnamenr = "6478"
```

## Watchlist:

“My” interesting sources, private or public  
Each source is Name, RA, Dec

[Create new watchlist](#)

### My Watchlists

Your private watchlists are listed below. Click "Create new watchlist" above to make a new one. Click on the name of the watchlist for more information and crossmatch.

Name	Description	Radius	Active	Public	
<a href="#">SDSS Quasar</a>	Main DR9 Quasar catalog with z<1.5 VII/269/dr9	0.1 arcsec	✓		<a href="#">(delete)</a>
<a href="#">Cataclysmic Variables</a>	Catalog of Cataclysmic Variables (Downes+ 2001-2006) Vizier V/123A	0.2 arcsec			<a href="#">(delete)</a>
<a href="#">WFCAM</a>	J/A+A/573/A100/WVSC Post annotation WFCAM Variable Star Catalog (Ferreira Lopes+, 2015) ReadMe+ftp2015A&A...573A.100F WFCAM Variable Star Catalog: parts C1 (periodic variables, table4), C2 (no main periodicity, table 6), and C3 (low-amplitude variables table 8) (334 rows)	1.0 arcsec	✓		<a href="#">(delete)</a>
<a href="#">BL Lac for TeV</a>	BL Lac candidates for TeV observations (Massaro+, 2013)	0.5 arcsec		✓	<a href="#">(delete)</a>
<a href="#">AM CVn</a>	These are 56 very close binaries of compact objects, from "The physical properties of AM CVn stars: new insights from Gaia DR2", Ramsey et al, <a href="https://arxiv.org/abs/1810.06548">https://arxiv.org/abs/1810.06548</a>	5.0 arcsec		✓	<a href="#">(delete)</a>



### Public Watchlists

Watchlists created and made public are listed below. Click on the name of the watchlist for more information and crossmatch.

Name	Owner	Description	Rac
<a href="#">BL Lac for TeV</a>	Roy Williams	BL Lac candidates for TeV observations (Massaro+, 2013)	0.5 arcsec

Name

Description

Radius (arcsec)

Active

Public

[Update watchlist](#)

Watchlist has 55 sources under watch.

watchlist crossmatched 18 matches found

[Run Crossmatch](#)

The "Run Crossmatch" button compares all ZTF transients with your watchlist source please be patient.

Watchlist			Crossmatch ZTF			
Object	RA	Dec	objectId	candidates	mag range	Sherlock class
SDSS J1411+4812	212.8263333	48.2159722	ZTF18aautxxk	65	7.6	CV
SDSS J1137+4054	174.3846667	40.91625	ZTF18aabwtmq	54	1.0	CV
KL Dra	291.159375	59.6963056	ZTF18aarkcxh	49	2.3	CV
CR Boo	207.2300833	7.9599444	ZTF18abaelhm	44	2.7	CV
PTF1 J1919+4815	289.7715833	48.2516667	ZTF18aaptcay	40	1.9	VS
PTF1 J0719+4858	109.8005	48.9763056	ZTF18aaaajmk	38	4.3	CV
SDSS J1240-0159	190.2417917	-1.9886667	ZTF18acyerom	29	0.2	CV
SDSS J0804+1616	121.2062083	16.2735833	ZTF18aaatipr	23	1.0	AGN
PTF1 J2219+3135	334.7920417	31.58975	ZTF18abcqadc	14	2.7	VS
SDSS J1043+5632	160.8545	56.5494444	ZTF18aabkmsj	10	2.7	VS
YZ LMi	141.6613333	36.4006944	ZTF17aackrzq	10	2.5	CV

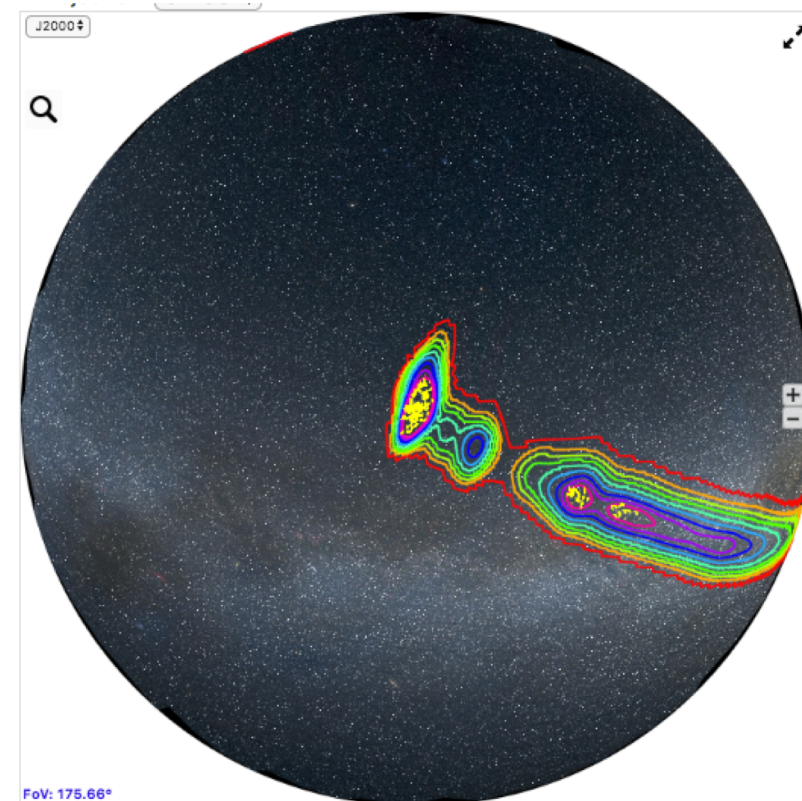
- GW skymaps
- Event of 2019-04-26
- Skymap has distance info
  - As does galaxy selection
- No galaxy has high prob
- Coverage of ZTF overlaid
- Recent transients overlaid

## Gravitational Wave Skymap: [S190426c](#)

Remember to click "submit" to refresh the page.

Distance	422.7 ± 127.8 Mpc
ISO Date:	2019-04-26T15:21:55.348060
Julian date:	2458600.140
Percent probability:	BNS=40, NSBH=10, BBH=50
max prob RA,Dec	6.3, 85.4

Coverage of ZTF      From  To   
 Show ZTF candidates      From  To   
 Show galaxies from [GLADE](#) *doubleclick a galaxy*



Fov: 175.66°

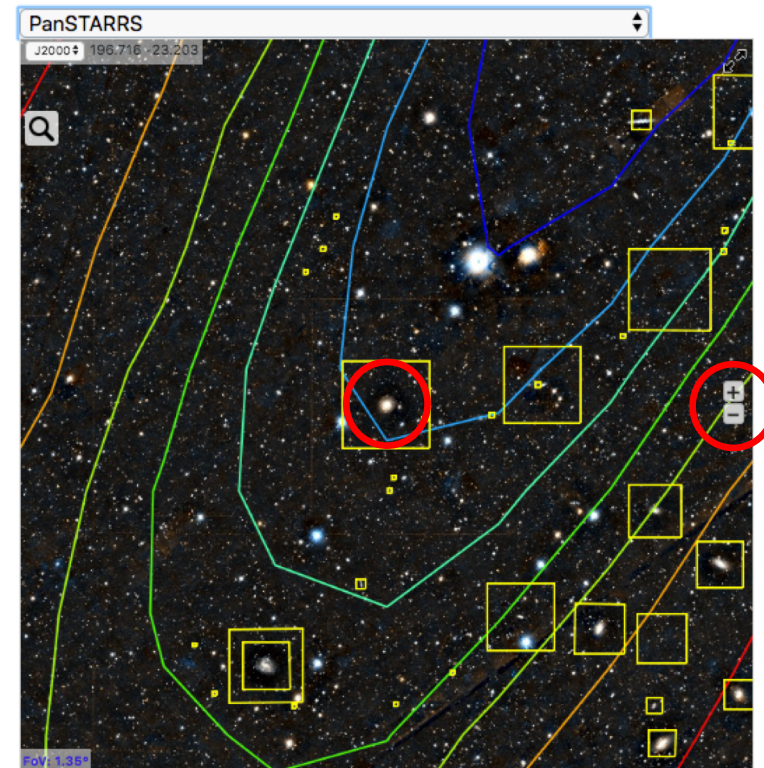
200 most probable galaxies

Name (NED link)	Percent probability	Distance (Mpc)
<a href="#">00143375+8524234</a>	0.03	332.3
<a href="#">00434058+8446222</a>	0.03	337.7
<a href="#">00152318+8610254</a>	0.03	353.0



- GW skymaps
- The famous GW170817
  - NGC4993 has 9% probability
  - Doubleclick yellow square
  - Select PanStarrs
  - Zoom with + and -

<https://lasair.roe.ac.uk/skymap/GW170817/>

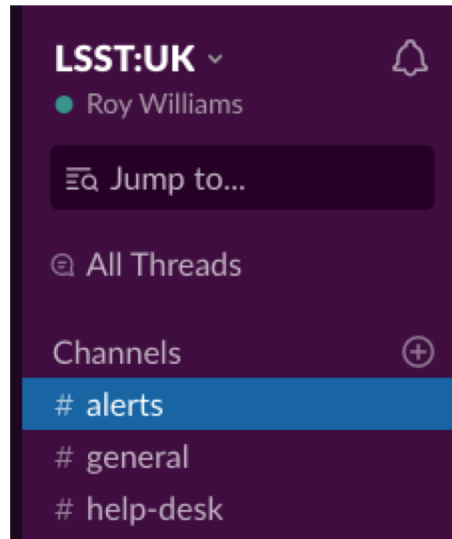


200 most probable galaxies

Name (NED link)	Percent probability	Distance (Mpc)
<a href="#">NGC4993</a>	9.11	39.35
<a href="#">PGC688666</a>	8.00	38.03
<a href="#">ESO508-014</a>	7.15	43.15
<a href="#">13104593-2351566</a>	6.53	38.72
<a href="#">ESO508-004</a>	6.46	30.51

## Pushing Alerts

LSST:UK slack  
channel #alerts



LSST:UK ▾  
● Roy Williams

Jump to...

All Threads




Channels

- # alerts
- # general
- # help-desk

### #alerts

☆ | 7 | 0 | Add a topic

Friday, May 3rd

-  **Lasair Bot** APP 4:34 PM  
New LVC skymap (0% prob BNS) at <https://lasair.roe.ac.uk/skymap/S190421ar/>
-  **Lasair Bot** APP 8:33 PM  
New LVC skymap (0% prob BNS) at <https://lasair.roe.ac.uk/skymap/S190503bf/>
-  **Lasair Bot** APP 8:42 PM  
New LVC skymap (0% prob BNS) at <https://lasair.roe.ac.uk/skymap/S190503bf/>



## • Coverage

- Shows ZTF “fields”
- Area = how many
- Red = r-band, Green = g-band
- Filter on date

## • AladinLite

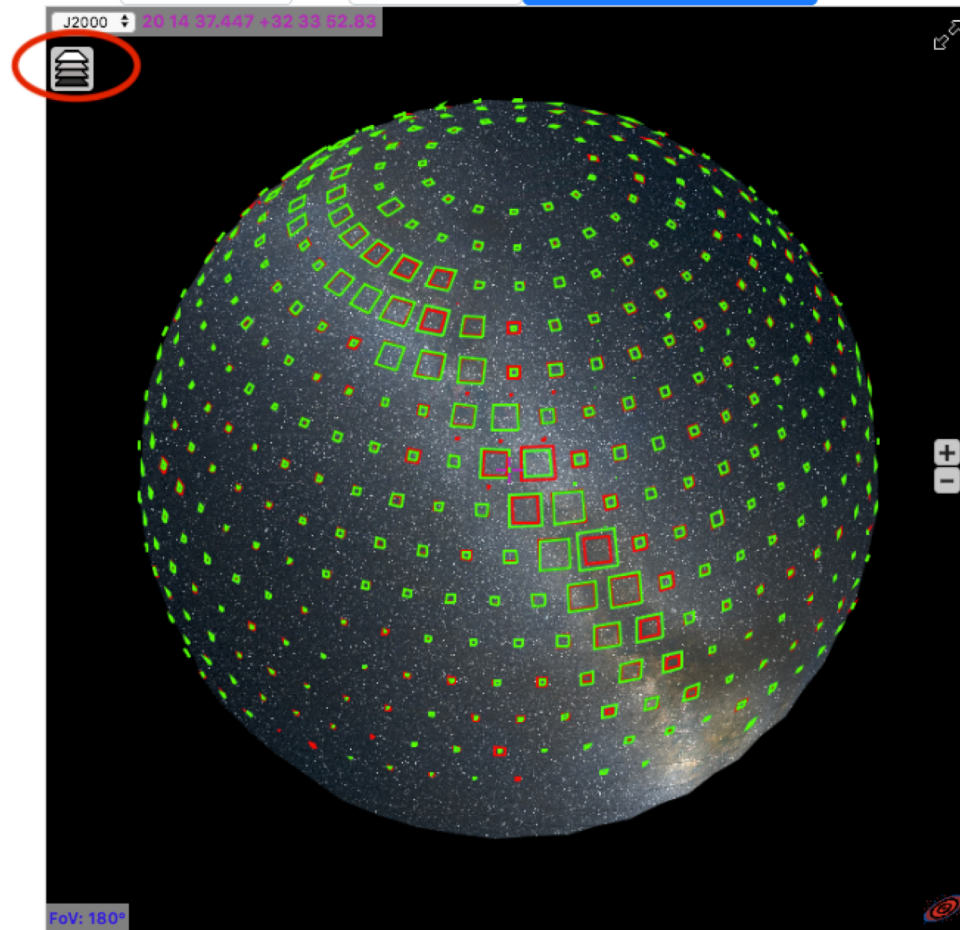
- Can spin, zoom, change background

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## ZTF coverage

Each ZTF field is shown the number of alerts found between the specified dates, for r-filter and green for g-filter. The special date "today" means the current UTC

From  To  [Map Coverage Query](#)



# Jupyter

<https://lasair.roe.ac.uk/jupyter> --> <https://jupyter.lsst.uk>

jupyter Home Token Logout

## Spawner Options

Image: ZTF Notebook

Size:  Tiny (256M / 0.25 CPU)  Small (1G / 1 CPU)  Large (8G / 4 CPU)  X-Large (24G / 12 CPU)

Spawn

## Finding KBO Makemake in ZTF

This code finds Makemake (136472) in the ZTF database

```

|: import mysql.connector
   %matplotlib inline
   import matplotlib.pyplot as plt
   import numpy as np
    
```

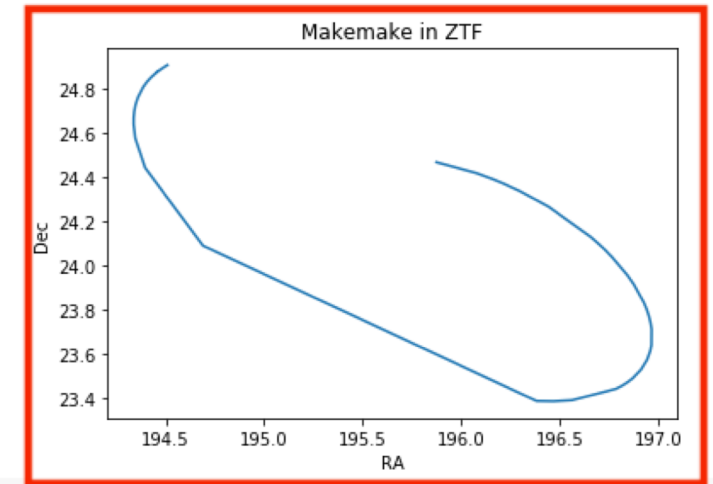
This SQL query finds all sightings of Makemake ordered by time

```

|: import settings
   msl = mysql.connector.connect(\
       user =settings.DB_USER, \
       password=settings.DB_PASS, \
       host =settings.DB_HOST, \
       database='ztf')
   cursor = msl.cursor(buffered=True, dictionary=True)
   query = 'SELECT jd,ra,decl FROM candidates WHERE ssnamenr="136472" ORDER BY jd'
   cursor.execute(query)
   n = cursor.rowcount
   print ('found %d sightings of Makemake' % n)
    
```

found 63 sightings of Makemake

Make the RA/Dec plot



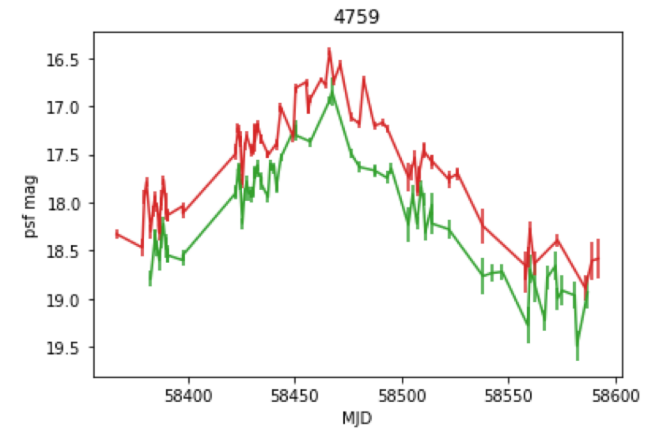
# Light curves of Minor Planets

Jupyter MinorPlanetLightcurves Last Checkpoint: Last Mor

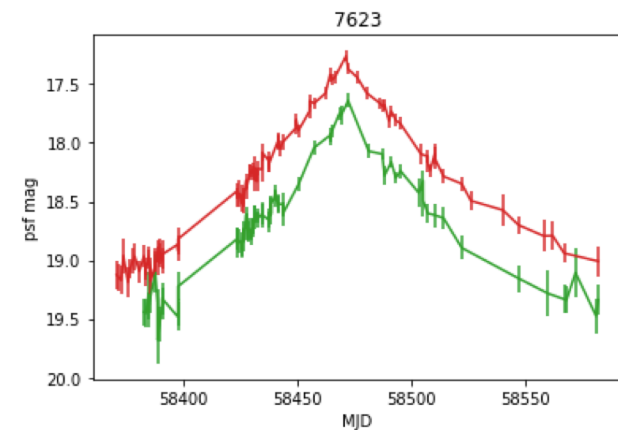
File Edit View Insert Cell Kernel Help

Run

Object 4759 has 168 detections



Object 7623 has 164 detections

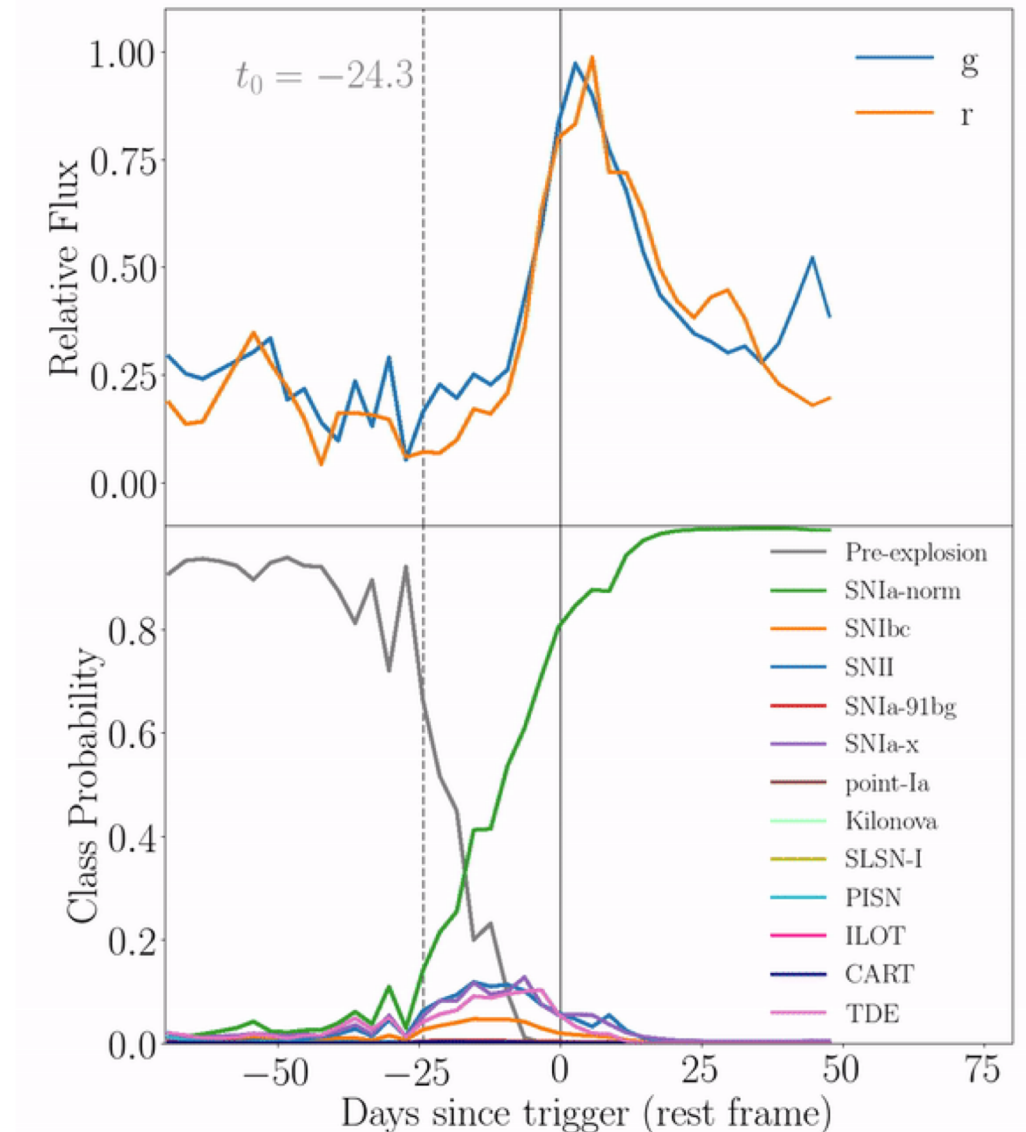


# Astrorapid

Muthukrishna et. al.

<https://arxiv.org/abs/1904.00014>

Could annotate the possible explosive transients with this annotation



- Future
  - High performance
    - More scalable infrastructure ... Spark, Cassandra, etc
    - Batch/Jupyter analysis
  - Surveys
    - Crossmatch, postage stamps, other time-domain, spectra
  - Filters
    - Combination filters from geometry, SQL
    - Annotations
      - Sherlock, light-curve ML, etc
  - Alerts
    - Message and automated followup

# Help us with the Lasair Roadmap

- Science Requirements <https://lsst-uk.atlassian.net/wiki/spaces/LUSCSWG/pages/614465537/LSST+UK+Science+Requirements+Document>
- Your Transient Astronomy
- How would you like to filter the LSST transient stream?
  - Express as geometry?
  - Computing on the light curve?
- What annotations should be computed?
  - For variable stars
  - For solar system science
  - For AGN and SMBH