

# Lasair -The UK: LSST Transient Server

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



Ken W. Smith

K.W. Smith, R. D. Williams, D. R. Young, A. Ibsen, S. J. Smartt, A. Lawrence, D. Morris, S. Voutsinas, and M. Nicholl  
2019, Research Notes of the American Astronomical Society, 3, 26

<http://adsabs.harvard.edu/abs/2019RNAAS...3a..26S>

# Lasair is being used

(2 recent ATels)

## SOAR telescope spectroscopic classification of optical transients

ATel #12671; [R. Cartier, C. Briceno, D. Gomez, J. Espinoza, O. Estay \(CTIO\)](#)

on 18 Apr 2019; 19:52 UT

*Distributed as an Instant Email Notice Supernovae*

*Credential Certification: Regis Cartier (rgcartier@gmail.com)*

Subjects: Optical, Supernovae

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As part of the SOAR telescope preparation for the Astronomical Event Observatory Network (AEON), 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 ATLAS survey, see Tonry et al. (2011, PASP, 123, 58) and Tonry et al. (ATel #8680). The observations were performed on the night of 15 April 2019 at the 4.1-m SOAR telescope equipped with the Goodman High Throughput Spectrograph using the 400 lines/mm grating, and a slit width of 1 arc second, resulting in a spectral resolution of 0.636 nm. Classifications were done with SNID (Blondin & Tonry, 2007, ApJ, 666, 1024).

Survey Name	IAU Name	RA (J2000)	Dec (J2000)	Disc. Date	Source	Disc Mag	z	Type	Phase
ZTF19aaozsuh	<a href="#">SN2019dde</a>	14:28:12.03	-01:36:15.0	2019-04-09	ZTF	18.11	0.057	IIn	at max
ATLAS19gde	<a href="#">SN2019dgh</a>	13:45:28.42	-06:01:48.7	2019-04-09	ATLAS	19.532	0.077	Ia	at max

## FDST spectroscopic classification of SN 2019dpu

ATel #12681; [M. Pursiainen \(University of Southampton\), C. Frohmaier \(University of Portsmouth - ICG\), P. Wiseman \(University of Southampton\), C. Inserra \(Cardiff University\), C. P. Gutierrez \(University of Southampton\), J. Anderson \(ESO\), C. Angus \(University of Southampton\), R. Cartier \(CTIO\), T.-W. Chen \(MPE\), T. de Jaeger \(UC Berkeley\), L. Galbany \(University of Pittsburg\), S. Gonzalez-Gaitan \(CENTRA\), M. Grayling \(University of Southampton\), H. Kuncarayakti \(University of Turku\), J. Lyman \(University of Warwick\), T. Muller-Bravo \(University of Southampton\), A. Pastorello \(INAF - Padova Astronomical Observatory\), R. Roy \(IUCAA\), T. Schweyer \(MPE\), M. Smith \(University of Southampton\), M. Sullivan \(University of Southampton\)](#)

on 23 Apr 2019; 16:03 UT

*Distributed as an Instant Email Notice Supernovae*

*Credential Certification: Philip Wiseman (p.s.wiseman@soton.ac.uk)*

Subjects: Optical, Supernovae

 Tweet

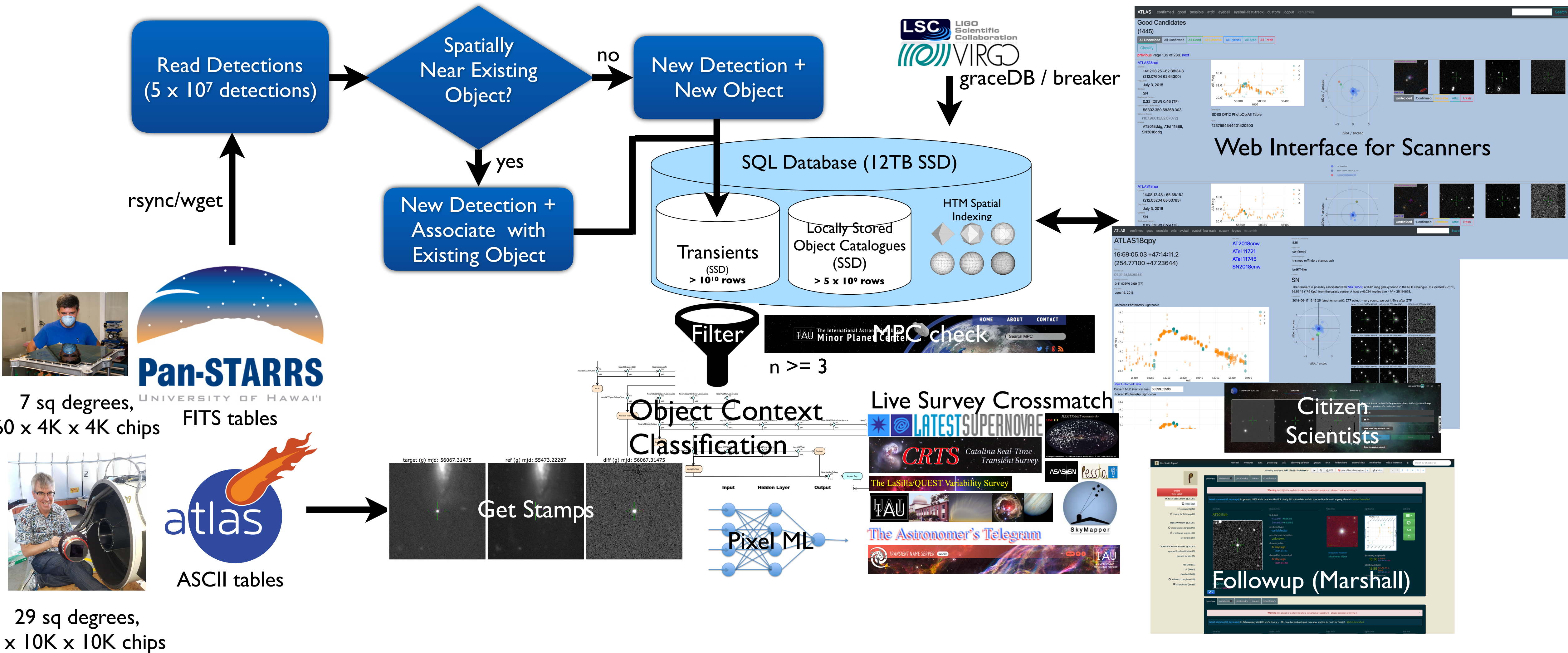
The Fast and Dark Side of Transients experiment (FDST; ATel #12362) reports the spectroscopic observation of [SN 2019dpu](#). The target was supplied by the Zwicky Transient Facility (<https://www.ztf.caltech.edu/>; Kulkarni et al. 2018, ATel 11266) and processed through the Lasair broker ([Smith, Williams,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

The observations were performed on 2019-04-22 using SPRAT (Piascik et al 2014) on the Liverpool Telescope (Steele et al. 2004).

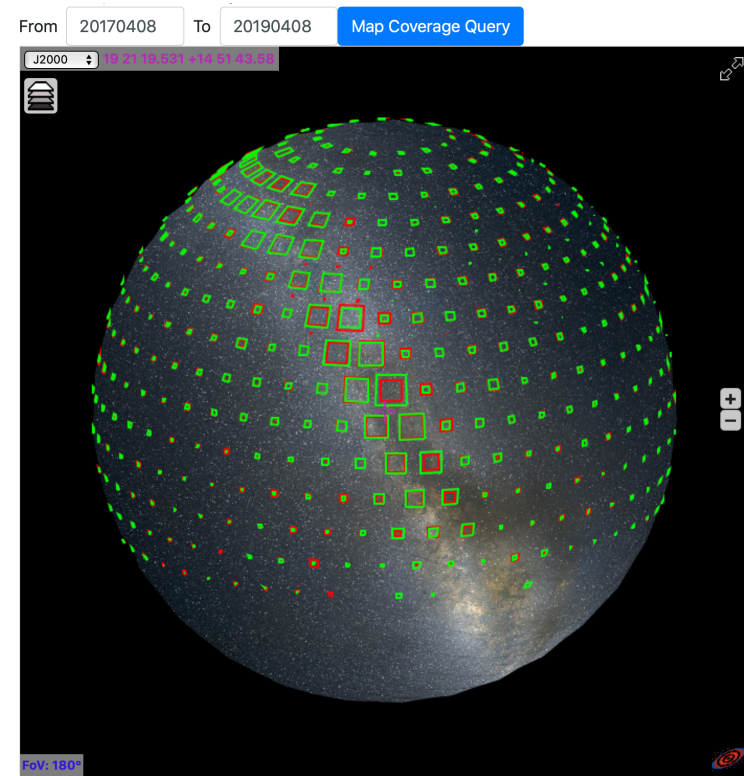
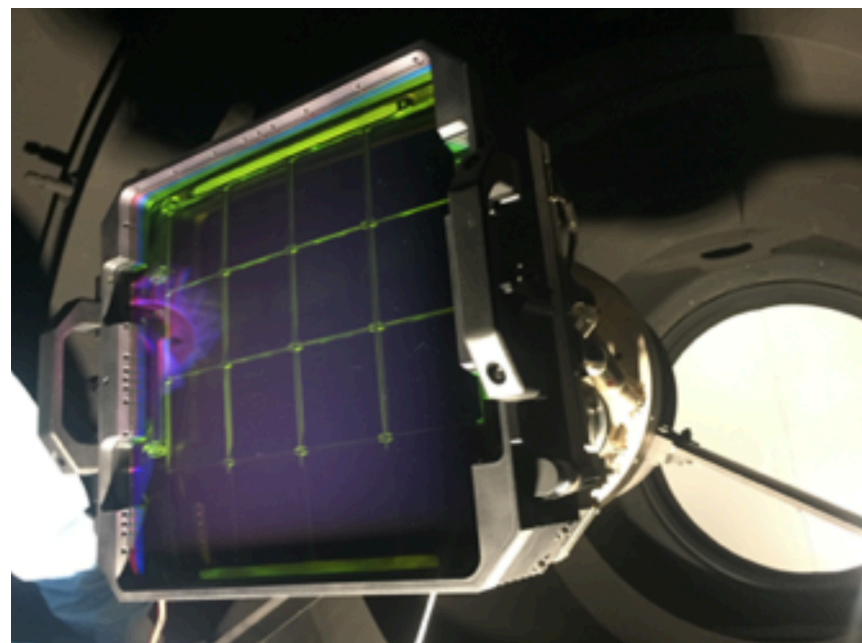
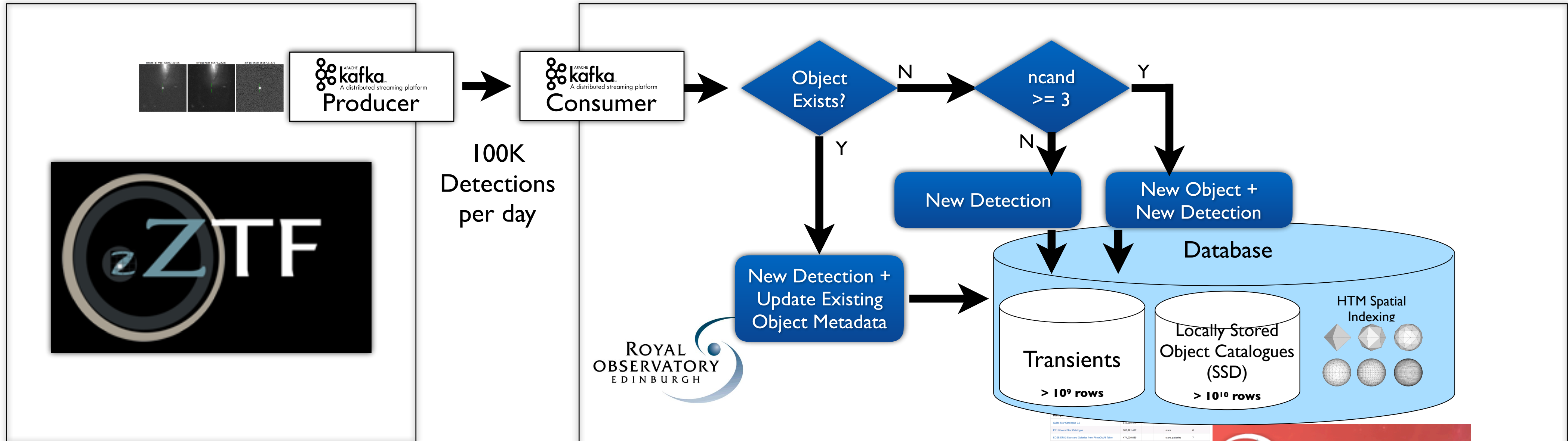
Survey Name	IAU Name	RA (J2000)	Dec (J2000)	Disc. Date	Source	Disc Mag	z	Type	Phase
ZTF2019aaqcqkv	<a href="#">SN2019dpu</a>	13:04:18.4	+33:28:15.7	20190412	ZTF	20.5	0.075	Ia	

(1) The redshift is obtained from the SNID fit. The phase obtained from SNID is -7 days.

# History: PSI and ATLAS Detection Ingest



# Lasair Prototype + ZTF



**Sherlock Context Classification** interface showing search results and the **TRANSIENT NAME SERVER** logo.

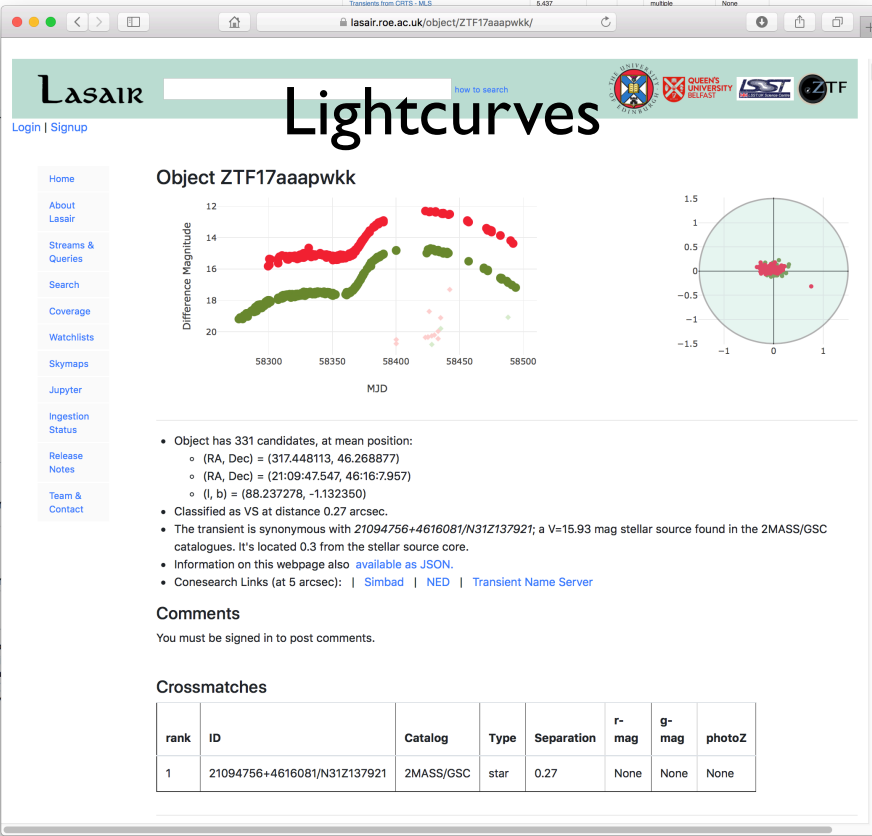
## User Defined Queries

```
Submit Query [refresh this box for JSON output '1']
SELECT DISTINCT
  o.objectId,
  o.frameId,
  o.decmean,
  o.jdmin - 2400000.5 AS mjdmn,
  o.jdmax - 2400000.5 AS mjdmx,
  o.ra,
  o.ra - 15 AS lra,
  IF(abs(ra) < 2 AND o.gscoord > 0.49, 'Within Galactic Plane', 'Outside Galactic Plane') AS gsp,
  o.eberlock_classification NOT IN ('VS', 'AGN') AS eberlock_classification,
  AND(o_sband > 20000) = 60 AS o_sband,
  AND(o_sband > 20) AS o_sband,
  AND(o_id > J2000) = 60 AS o_id,
  AND(o_magpf < 20) AS o_magpf,
  AND(o_rz >= 0.75) AS o_rz,
  AND(o_nbad = 0) AS o_nbad,
  AND(o_isdiffpos = 't') AS o_isdiffpos,
  AND(o_fwhm <= 5) AS o_fwhm,
  AND(ABS(c_magdiff) <= 0.1) AS c_magdiff,
  AND(o_long <= 1.2) AS o_long,
ORDER BY score, mjdmn DESC
```

### Contributed Stored Queries

Stored queries created and made public are listed below. Click on the name to view the query details.

Name	Owner	Description	Query
Recent high glt	Roy Williams	Recently observed objects (last 12 hours), with high galactic latitude.	SELECT FROM obj AND ABS(lat) > 10 AND ABS(lon) < 10 ORDER BY score



### Watchlists

Public Watchlists

Name	Owner	Description	Radius	Active
BL Lac for TeV	Roy Williams	BL Lac candidates for TeV observations (Messer+ 2013)	0.5 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", Ramsey et al. https://arxiv.org/abs/1810.06548	5.0 arcsec	

# LASAIR Object search

by object name & coordinates

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## Discovery of 9 ASAS-SN Super

ATel #12296; *J. Brimacombe (Coral Towers Observatory), J. A. M... Spain), R. Cornect (Moondyne Observatory), N. Castro, A. Cloccl... (Observatory Inmaculada del Molino), P. Vallely, K. Z. Stanek, C... Thompson (Ohio State), B. J. Shappee (IfA-Hawaii), T. W.-S. Hol... J. L. Prieto (Diego Portales; MAS), D. Bersier (LJMU), Subo Don... PKU), M. Stritzinger, S. Holmbo (Aarhus), G. Bock (Runaway Be... Stone (Sierra Remote Observatories),*  
on 14 Dec 2018; 16:42 UT  
Distributed as an Instant Email Notice Super  
Credential Certification: Patrick Vallely (vallely).

Subjects: Optical, Supernovae, Transient

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During the ongoing All Sky Automated Survey for SuperNovae (ASAS-SN) using data from the quadruple 14-cm "Brutus" telescope in Haleakala, the "Leavitt" telescope in Fort Davis, Texas, the quadruple 14-cm "P... Sutherland, South Africa, and the quadruple 14-cm "Cassius" and "Tololo, Chile, we discovered several new transient sources. Properties associated finding charts showing the archival imaging (left) and the (right) are included in the table below:

Object	RA (J2000)	DEC (J2000)	Redshift	Disc.
ASASSN-18abp (AT 2018jcw)	00:48:03.105	+16:00:58.08	Unk	2018-
ASASSN-18abk (AT 2018jrv)	00:48:03.105	+16:00:58.08	0.050269	2018-
ASASSN-18abi (AT 2018jrn)	00:48:03.105	+16:00:58.08	0.022456	2018-
ASASSN-18abg (AT 2018jri)	04:33:55.385	-48:57:53.23	0.055528	2018-
ASASSN-18abd (AT 2018jpd)	23:42:03.807	-42:28:19.74	0.061276	2018-
ASASSN-18aba (AT 2018jlo)	02:02:17.467	-13:56:34.77	Unk	2018-
ASASSN-18aay (AT 2018jky)	03:26:02.117	-17:33:46.95	0.014580	2018-
ASASSN-18aax (AT 2018jkd)	01:56:50.465	-67:43:27.59	Unk	2018-
ASASSN-18aaa (AT 2018jka)	00:02:55.838	-26:52:51.11	0.066586	2018-

LasAIR

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### 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. You can also enter an objectId, beginning with 'ZTF'.

RA Dec radius: 00:48:03.105 +16:00:58.08

[Run Cone Search](#)

RA,Dec,radius=12.01294,16.01613,5.0  
1 objects found in cone

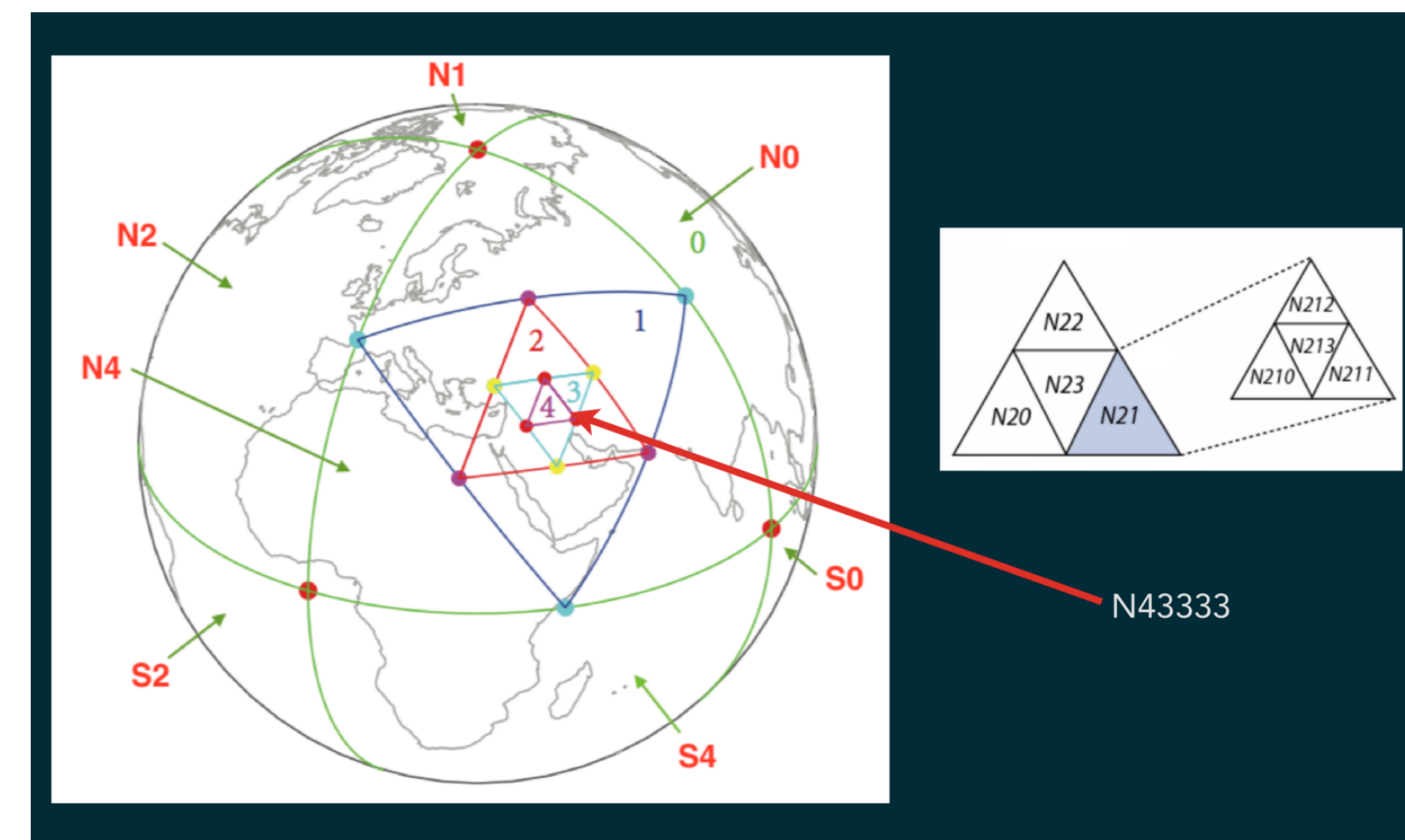
ZTF object	RA	Dec	Arcsec
ZTF18acdyyo	12.012851	16.016185	0.4

# LASAIR Context Classification

<https://github.com/thespacedoctor/sherlock>

“Sherlock” Catalogues (10<sup>10</sup> objects)

Description	Number Rows	Vizier	NED	Objects	Weight (1-10)
Guide Star Catalogue 2.3	945,569,477	✓		stars	3
PS1 Ubercal Star Catalogue	706,861,417			stars	6
SDSS DR12 Stars and Galaxies from PhotoObjAll Table	474,039,669			stars, galaxies	7
2MASS Point Source Catalogue	470,992,970	✓	✓	stars	5
A stream of NED sources -- built as transients matched again	13,703,332		✓	multiple	8
SDSS DR12 Galaxies and QSOs from specObjAll table	3,050,811			galaxies, QSOs	10
2MASS Extended Source Catalogue	1,647,599	✓	✓	galaxies	5
Million Quasars (MILLIQUAS) Catalog	1,153,111			QSOs, AGN, BL Lac	10
Catalog of Quasars and Active Galactic Nuclei by Veron-Cett	168,944	✓		QSOs, AGN, BL Lac	10
NED-D Galaxy Catalogue	94,959			galaxies	8
Kepler 2 Campaign Galaxies	11,905			galaxies	7
Coordinates parsed from ATels	6,316			multiple	None
SNe in the Bright Supernova List	6,289			SNe	None
SN candidates from PSST	5,855			SN Candidates	None
Transients from CRTS - MLS	5,437			multiple	None
Transients from CRTS - CSS	5,083			multiple	None
SN candidates from LSQ	3,031			SN Candidates	None
Catalog and Atlas of Cataclysmic Variables	1,830	✓		CVs	10
Cataclysmic Binaries Catalog	1,721	✓		CVs, LMXB	10
Galaxies from the IFS survey	1,088			galaxies	10
The all-transients stream from ASASSN	1,002			multiple	None
Candidate from TOCP pages	836			multiple	None
SN candidates from the OGLE survey	728			SN Candidates	None
Transients from CRTS - SSS	694			multiple	None
SN candidates from PESSTO users	487			SN Candidates	None
The potential SN stream from ASASSN	308			SN Candidates	None



HTM Indexing Scheme

MySQL Catalogue Database

# LASAIR Context Classification

<https://github.com/thespacedoctor/sherlock>

## “Sherlock”: Programmable Algorithms for Event Annotation

```
search algorithm:
  GSC star 1:
    database table: tcs_view_star_guide_star_catalogue_v2_3
    mag column: V
    bright:
      mag limit: 16.
      angular radius arcsec: 100.0
      synonym: VS
      association: BS
    faint:
      mag limit: 19.5
      angular radius arcsec: 2.0
      annotation: SN
    general:
      angular radius arcsec: 0.5
      synonym: VS
```

```
GSC star 2:
  database table: tcs_view_star_guide_star_catalogue_v2_3
  mag column: B
  bright:
    mag limit: 16.
    angular radius arcsec: 100.0
    synonym: VS
    association: BS
  faint:
    mag limit: 19.5
    angular radius arcsec: 2.0
    annotation: SN
  general:
    angular radius arcsec: 0.5
    synonym: VS
```

```
GSC unknown:
  database table: tcs_view_unknown_guide_star_catalogue_v2_3
  general:
    angular radius arcsec: 2.0
    annotation: UNCLEAR
```

```
2mass star:
```

### Search Module Parameters

- angular separation crossmatch radius
- physical separation crossmatch radius
- source magnitude filtering
- magnitude dependent search radii for bright stars and galaxies

### Classifications & Reliabilities

- transient given a predicted classification based on the parameters of the catalogued source it matches against
- transients can be given multiple classifications which are later ranked
- a transient can either be **synonymous** with (within 0.5”), **associated** with (>0.5” away) or **annotated** by a catalogued source

Search Algorithms are written in  
YAML - plain text

# Lasair Context Classification

Lasair

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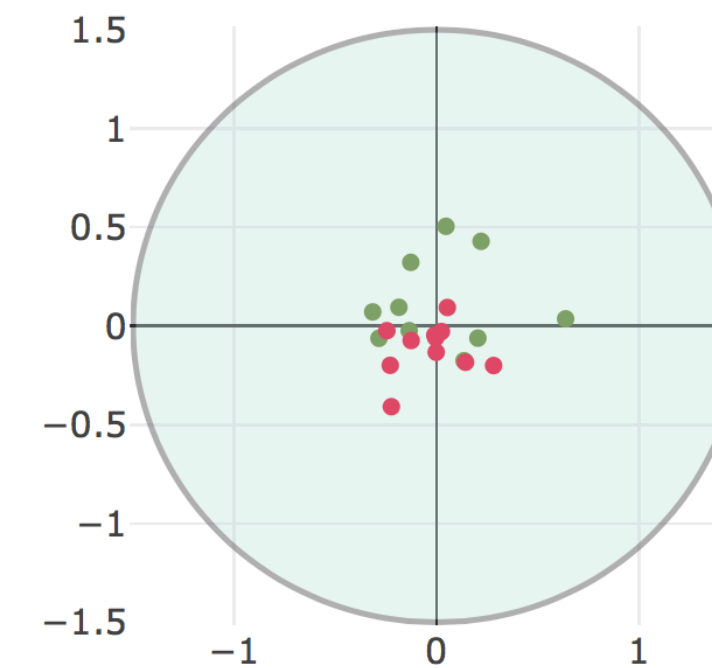
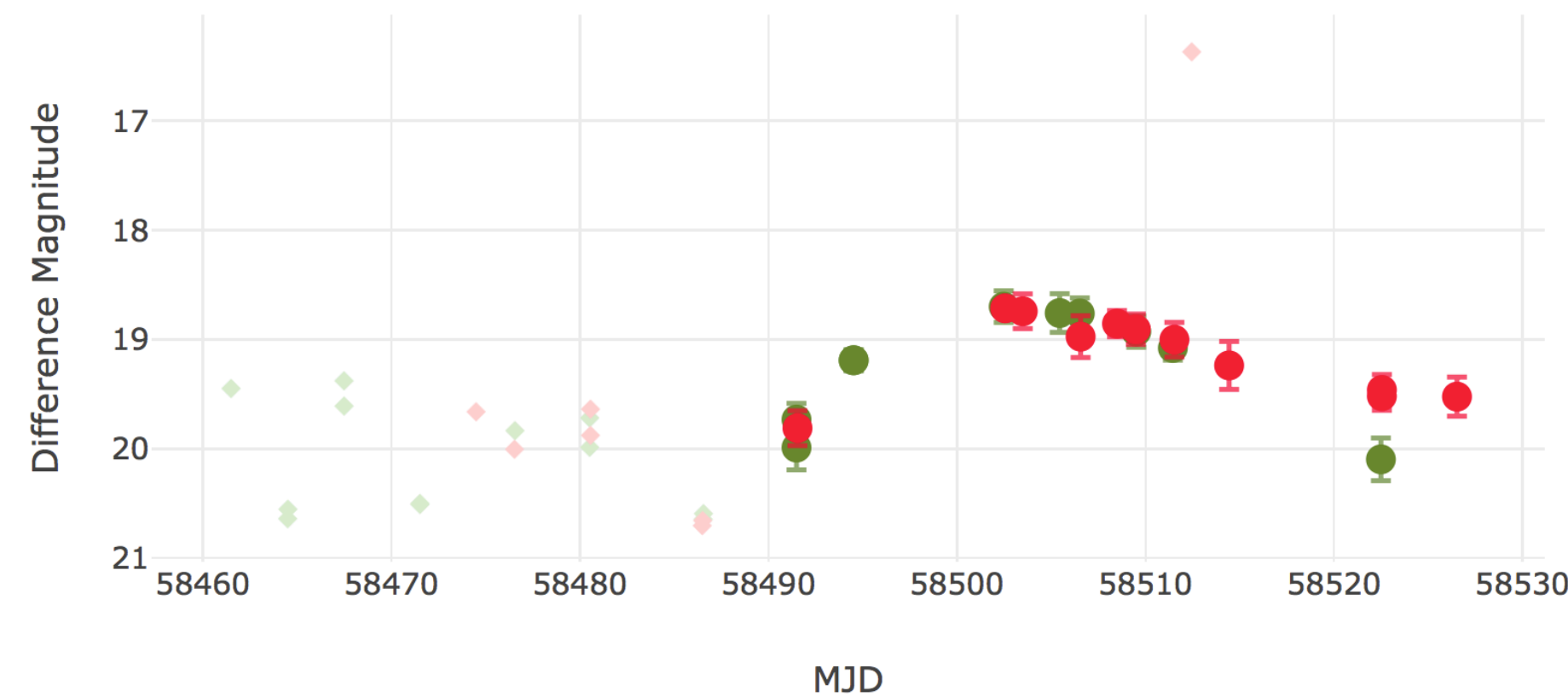
[Jupyter](#)

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## Object ZTF19aabyuzq



- Object has 22 candidates, at mean position:

- (RA, Dec) = (190.407813, 48.268959)
- (RA, Dec) = (12:41:37.875, 48:16:8.254)
- (l, b) = (127.442522, 68.773313)

- Classified as SN at distance 2.05 arcsec.
- The transient is possibly associated with [SDSS J124137.68+481608.0](#); an r=18.88 mag galaxy found in the SDSS DR12 PhotoObjAll Table catalogue. It's located 0.31 N, 2.03 E (3.9 Kpc) from the galaxy centre. A host photoZ=0.104 ( $\pm 0.040$ ) implies a transient  $M = -18.59$ .

• Information on this webpage also [available as JSON](#).

• Conesearch Links (at 5 arcsec): | [Simbad](#) | [NED](#) | [Transient Name Server](#)

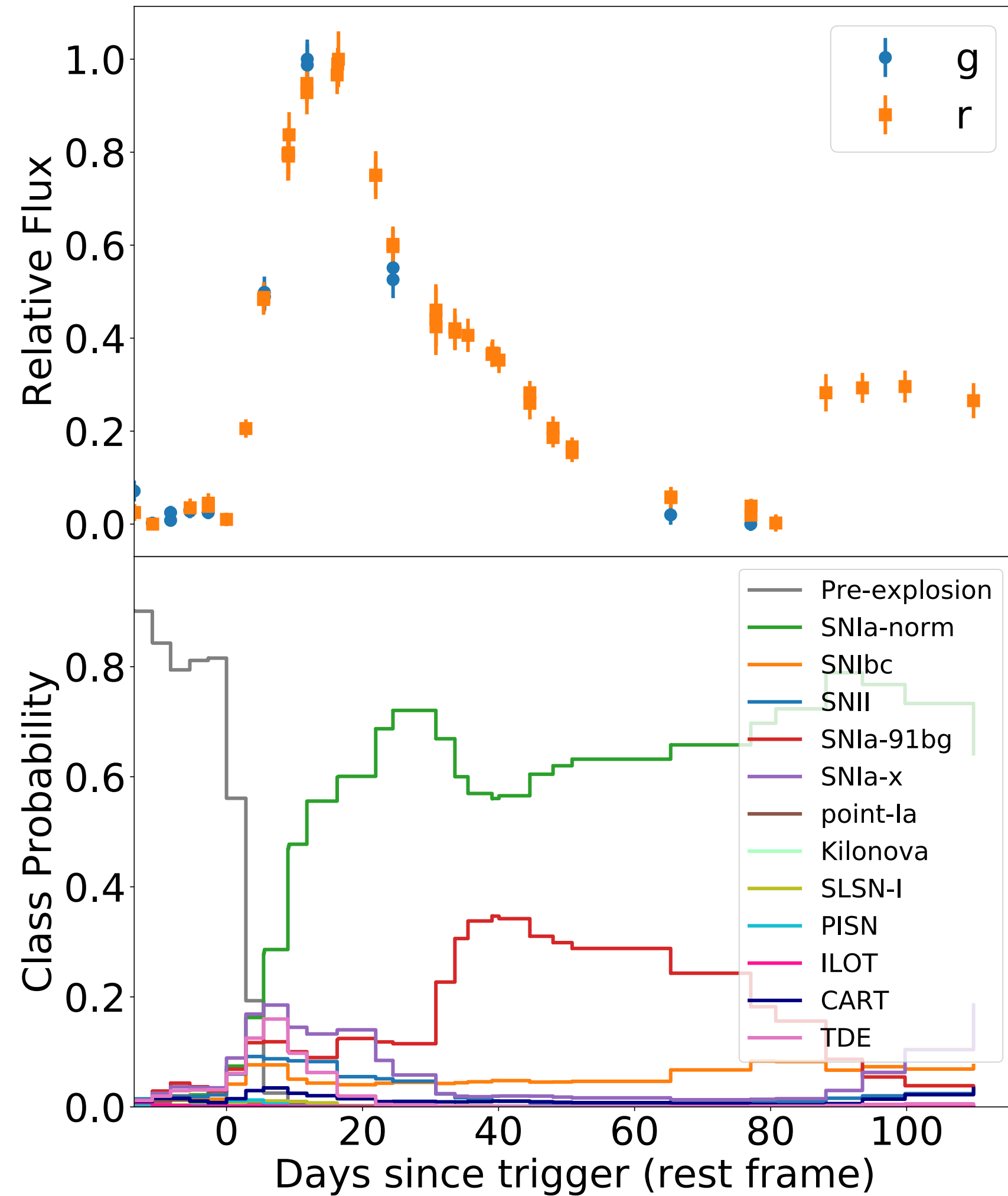
## Comments

Lasair	Jan. 26, 2019,	In TNS as <a href="#">AT2019ql</a> at 0.1 arcsec, discovered 2019-01-08 12:55:11
Bot	1:36 p.m.	(MJD 58491.00) by ZTF



# LASAIR Lightcurve Classification

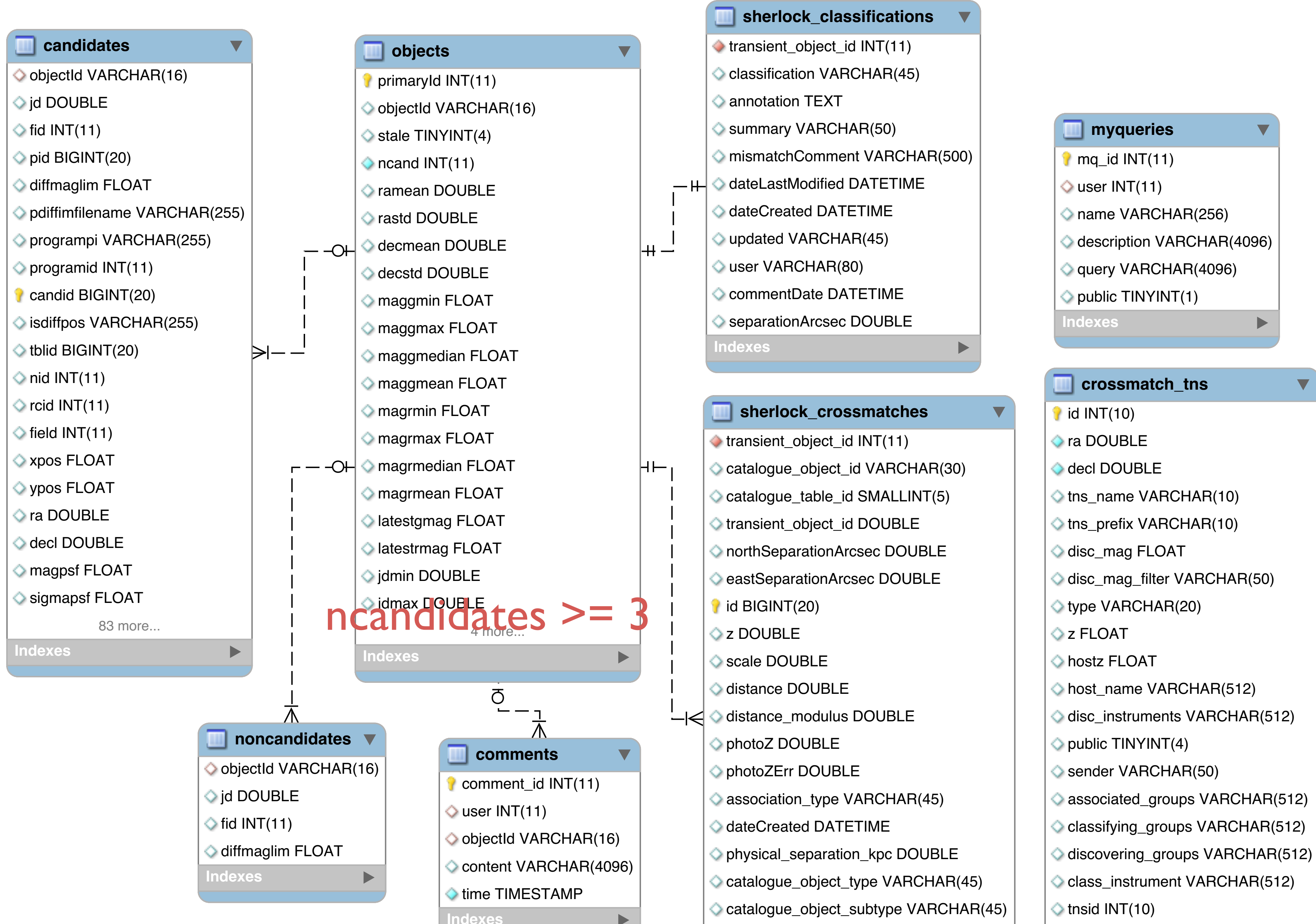
Integration of RAPID early lightcurve classifier coming soon!



Daniel Muthukrishna

<https://astrorapid.readthedocs.io/en/latest/>

# Lasair User Queries

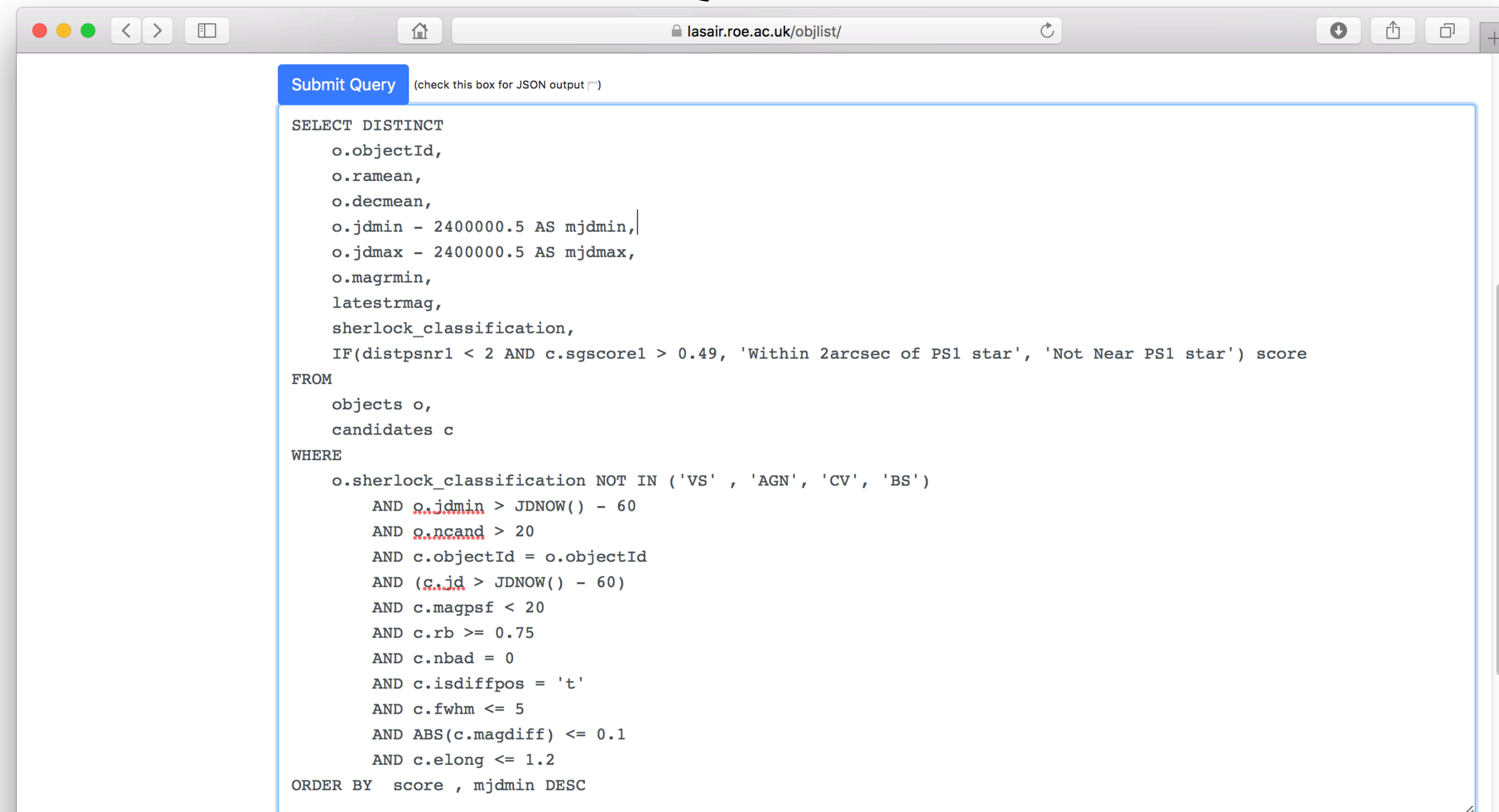


# LASAIR User Queries

User can make their own queries and choose private or public

Community provided public queries

Default “stream” queries supplied



Submit Query (check this box for JSON output)

```
SELECT DISTINCT
  o.objectId,
  o.ramean,
  o.decmean,
  o.jdmin - 2400000.5 AS mjadmin,
  o.jdmax - 2400000.5 AS mjdmax,
  o.magrmin,
  latestrmag,
  sherlock_classification,
  IF(distpsnr1 < 2 AND c.sgscore1 > 0.49, 'Within 2arcsec of PS1 star', 'Not Near PS1 star') score
FROM
  objects o,
  candidates c
WHERE
  o.sherlock_classification NOT IN ('VS' , 'AGN', 'CV', 'BS')
  AND o.jdmin > JDNOW() - 60
  AND o.ncand > 20
  AND c.objectId = o.objectId
  AND (c.jd > JDNOW() - 60)
  AND c.magpsf < 20
  AND c.rb >= 0.75
  AND c.nbad = 0
  AND c.isdiffpos = 't'
  AND c.fwhm <= 5
  AND ABS(c.magdiff) <= 0.1
  AND c.elong <= 1.2
ORDER BY score , mjadmin DESC
```

(If you would like to create your own stored queries, you should be signed in. See links at top left.)

## Contributed Stored Queries

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

Name	Owner	Description	Query
<a href="#">Recent high glat</a>	Roy Williams	Recently observed objects (last 12 hours), with high galactic latitude.	SELECT objectId, ncand FROM objects WHERE jdmax > jdnw() - 0.5 AND abs(glatmean) > 10.0 ORDER BY ncand DESC
<a href="#">Recent solar system</a>	Roy Williams	Recently observed solar system candidates (last 12 hours)	SELECT objectId, ssmagnr AS magnitude, ssnamenr as MPC_name FROM candidates WHERE ssdistnr BETWEEN 0.0 and 5.0 AND jd > jdnw() - 0.5 ORDER BY jd DESC
<a href="#">Active CVs</a>	Roy Williams	Cataclysmic variables with wide swings in magnitude	SELECT objectId, ncand, maggmean, magrmean FROM objects WHERE (magmax - magmin > 2.00 OR magmax - magmin > 2)

# Lasair Watchlists

Browser address bar: lasair.roe.ac.uk/watchlist/

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A watchlist is a set of points in the sky, together with a radius in arcseconds. It is assumed to be a list of "interesting" sources, so that any transient that falls within the radius of one of the sources might indicate activity of that source. Each user of the Lasair system has their own set of watchlists, and can be alerted when a ZTF transient is coincident with a watchlist source.

You can create a watchlist of sources by preparing a text file, where each comma-separated line has an identifier for the source, then the RA and Dec in decimal degrees. One way to do this is with [Vizier](#) and a spreadsheet program such as Excel or Numbers. Here is [an example of the CSV data](#). The 42 entries are *BL Lac candidates for TeV observations (Massaro+, 2013)*

An "Active" watchlist is one that is compared immediately when new ZTF candidates are ingested, with an alert sent immediately to the owner of the watchlist. (This feature is not yet implemented).

[Create new watchlist](#)

**Up to several thousand objects per list (at the moment)**

### 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 crossmatching.

Name	Description	Radius	Active	Public
------	-------------	--------	--------	--------

**Can be public or private**

### Public Watchlists

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

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

# LASAIR and GW Events

Coverage of ZTF From  To

Show ZTF candidates From  To

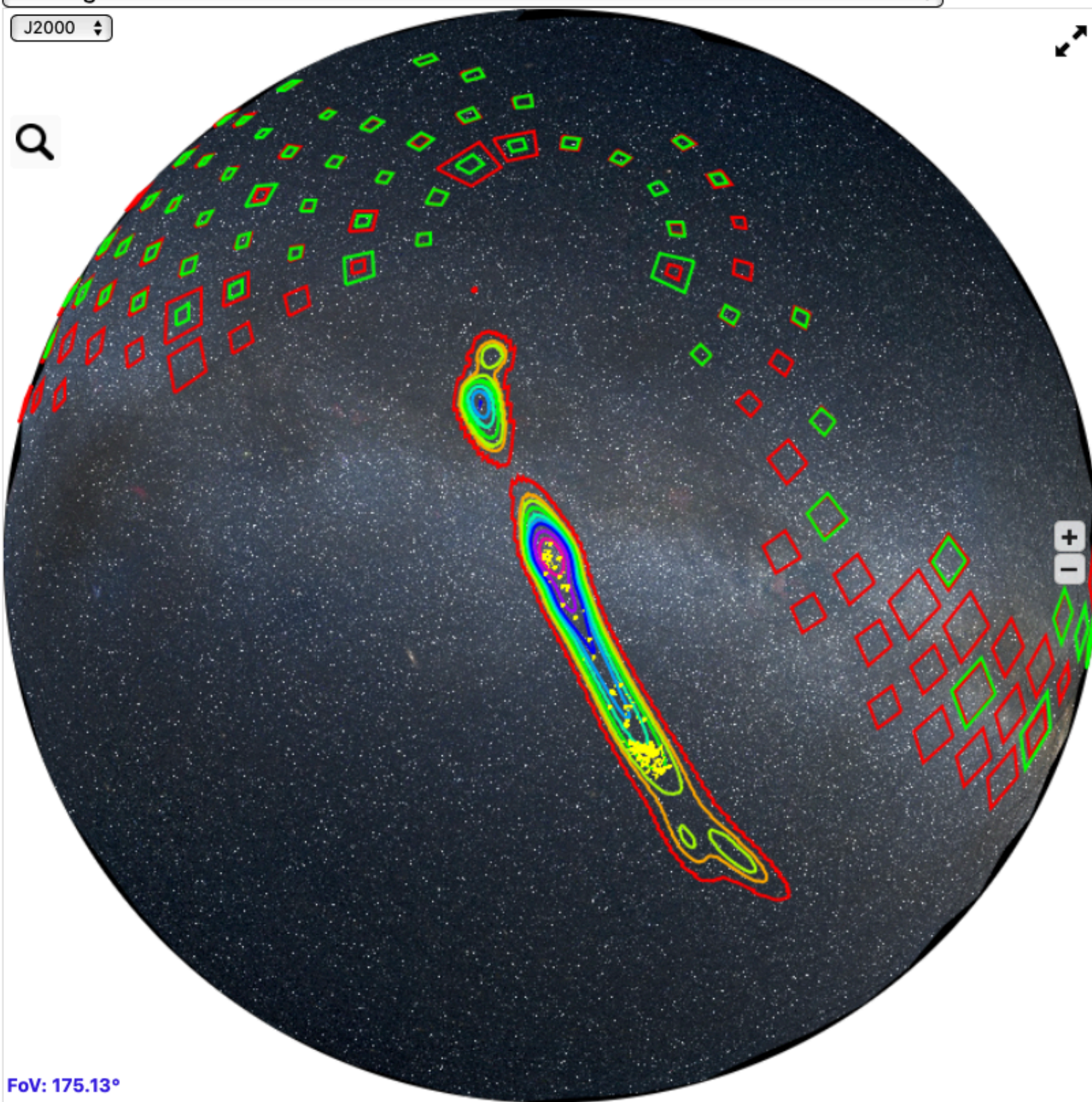
Show galaxies from [GLADE](#) *doubleclick a galaxy*

Submit

0 ZTF sources found

Mellinger coloured

J2000



FoV: 175.13°

200 most probable galaxies

Coverage of ZTF From  To

Show ZTF candidates From  To

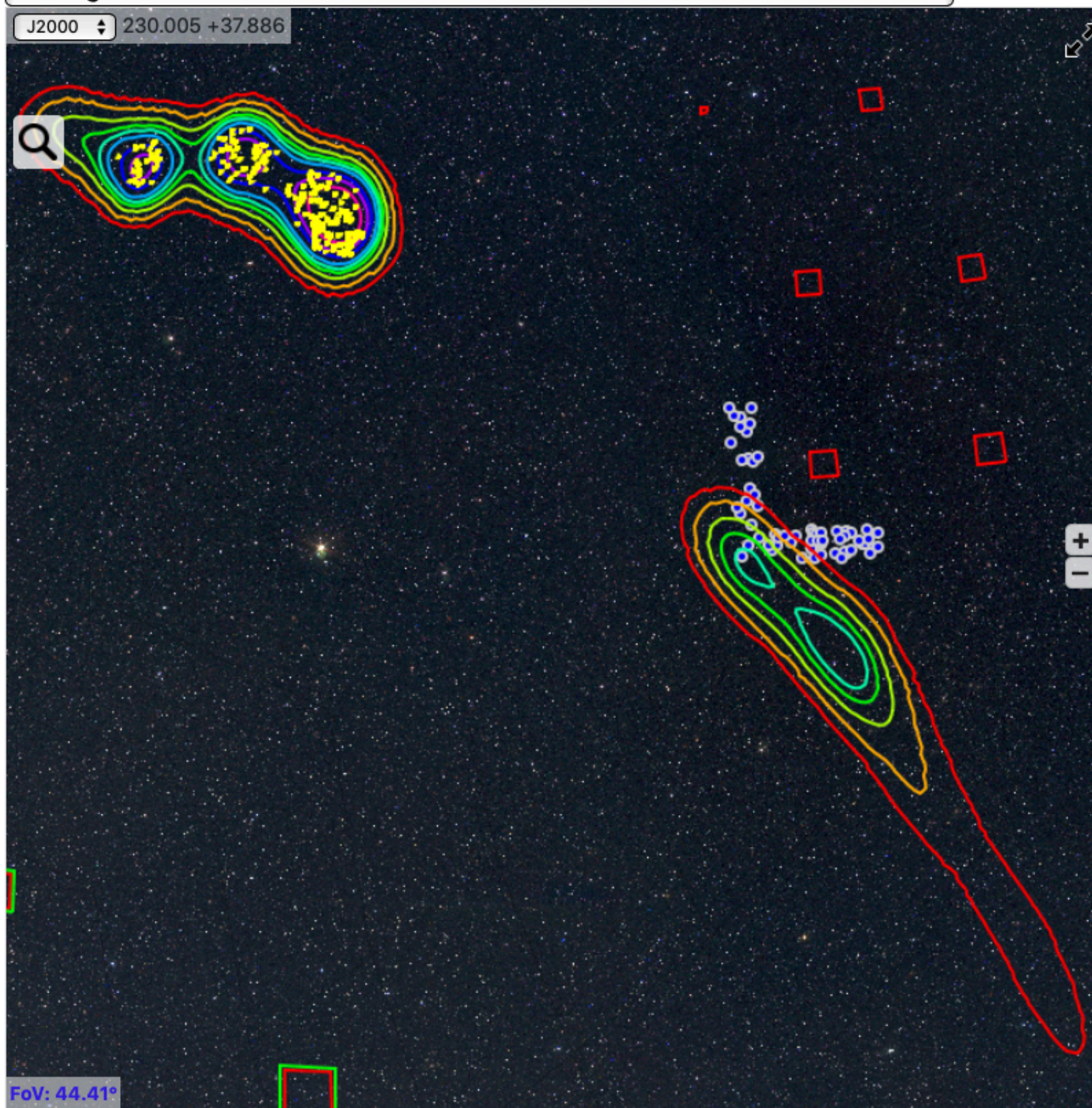
Show galaxies from [GLADE](#) *doubleclick a galaxy*

Submit

62 ZTF sources found

Mellinger coloured

J2000 230.005 +37.886



FoV: 44.41°

200 most probable galaxies

Coverage of ZTF From  To

Show ZTF candidates From  To

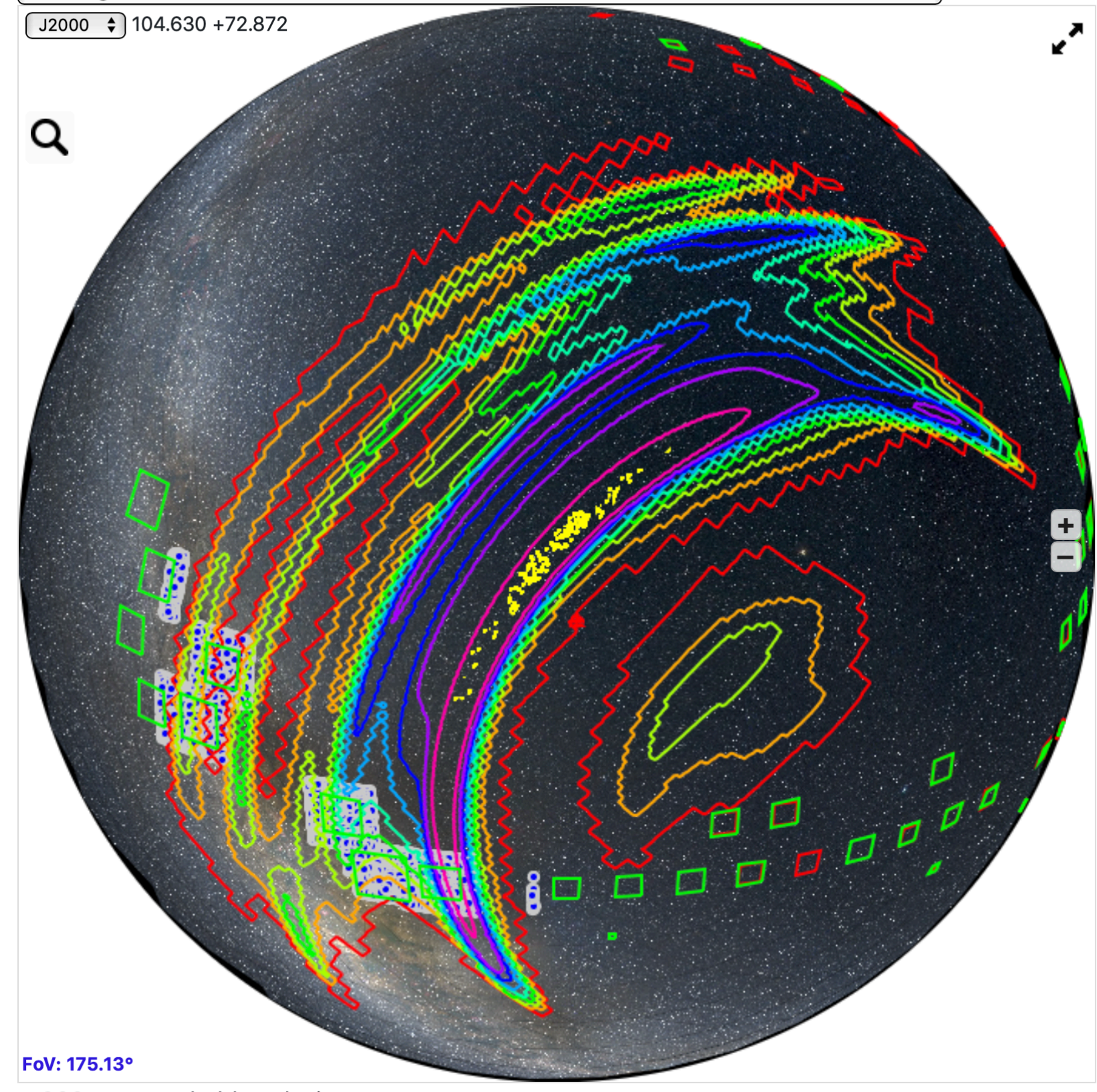
Show galaxies from [GLADE](#) *doubleclick a galaxy*

Submit

15684 ZTF sources found

Mellinger coloured

J2000 104.630 +72.872



FoV: 175.13°

200 most probable galaxies

# LASAIR and GW Events



confirmed ▾ good ▾ possible ▾ attic ▾ eyeball ▾ eyeball-fast-track ▾ custom logout ken.smith

Search

## Good Candidates

(22)

All Undecided All Possible All Eyeball All Attic All Trash

Classify

Page 1 of 1.

### ATLAS19hvy (2019dyt)

Coords:  
14:24:48.60 +02:39:06.3  
(216.20250 2.65175)

Galactic Coords  
(349.32344,56.86270)

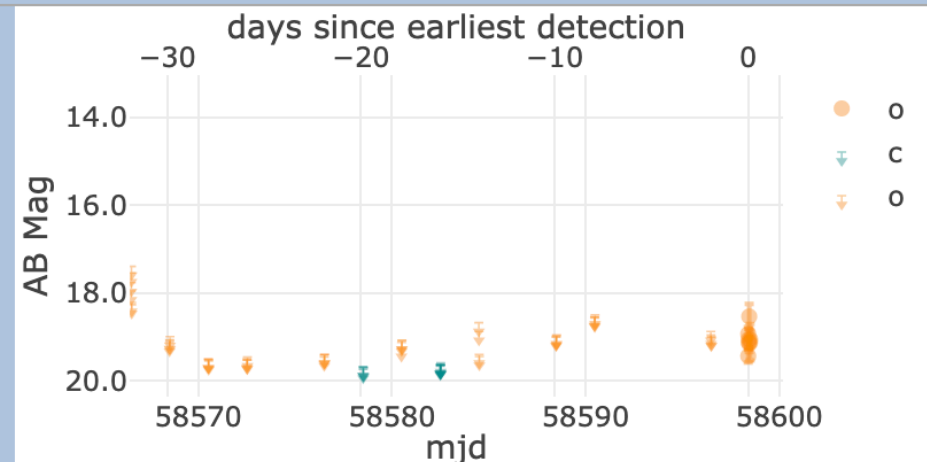
Flag Date:  
April 25, 2019

Context  
SN

Realbogus Factors  
0.13 (DEW) 0.55 (TF)

Earliest and Latest MJDs  
58598.404 58598.502

GW Events  
GW190425 (80%)



Catalogue:

NED

Host:

2MASX J14244743+0239520

z (spec):

0.05

Distance:

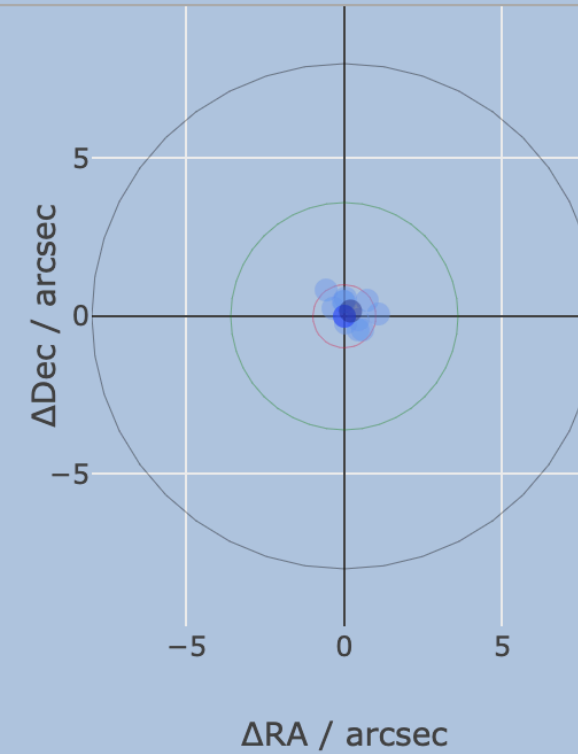
238.6 Mpc

Distance Modulus:

36.89

Physical Offset:

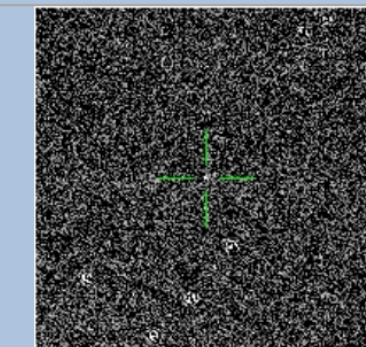
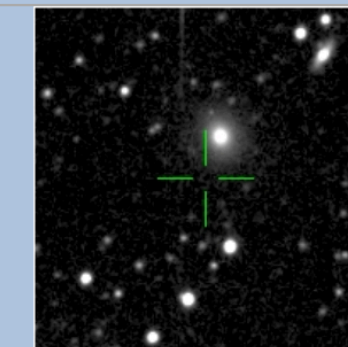
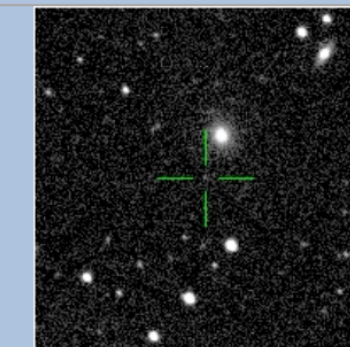
51.11 Kpc



● 1st detection  
● mean coords (rms = 0.60)



Undecided Possible Attic Trash



### ATLAS19hvw (2019dyv)

Coords:  
14:33:43.63 +30:12:55.6  
(218.43181 30.21545)

Galactic Coords  
(46.85293,67.40014)

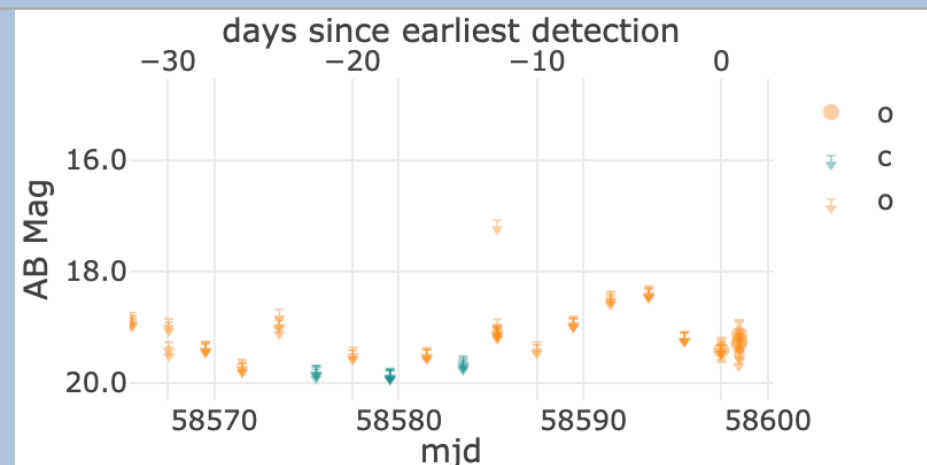
Flag Date:  
April 25, 2019

Context  
NT

Realbogus Factors  
0.08 (DEW) 0.57 (TF)

Earliest and Latest MJDs  
58597.476 58598.476

GW Events  
GW190425 (70%)

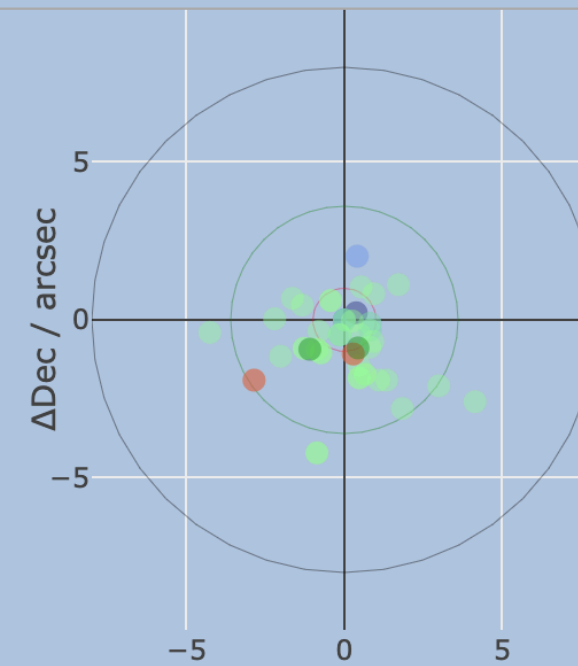


Catalogue:

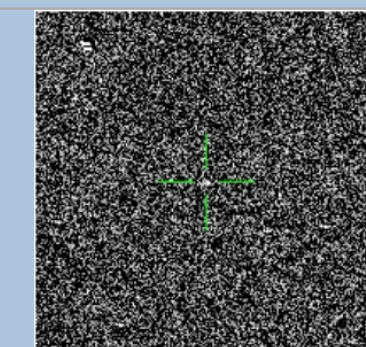
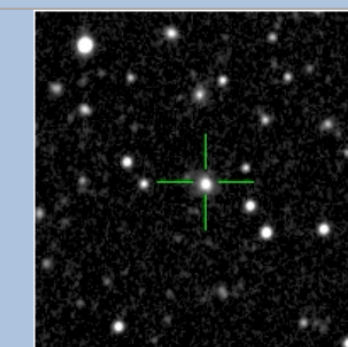
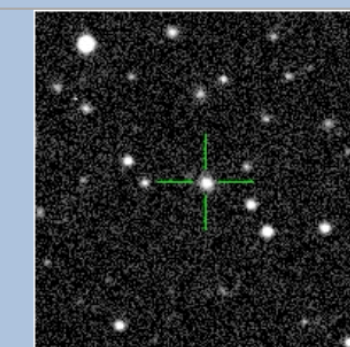
SDSS DR12 SpecObjAll Table

Host:

1237665102212628601



Undecided Possible Attic Trash



# Lasair UK Workshop

## October 2018: Resulting Requirements

### **Near term requirements**

LIGO - Virgo object tagging for O3 (starting soon!)

APIs (e.g. TAP service for querying Lasair)

User defined alert mechanism (e.g. SMS)

Jupyter:

Make Jupyter available to all users - with "Overviews", "How-tos", "Getting started" pages

Provide standard queries for Jupyter notebooks

Allow private areas/folders and the ability to define groups within the Jupyter hub

Have ability for Jupyter notebooks to run automatically.

### **Longer term requirements**

Provide a mechanism for allowing lightcurve analysis code to be uploaded

Vizier integration to allow spectra of objects in watch list to be pulled

Model and empirical lightcurve fitting

Lightcurve mashing from user-provided and other surveys

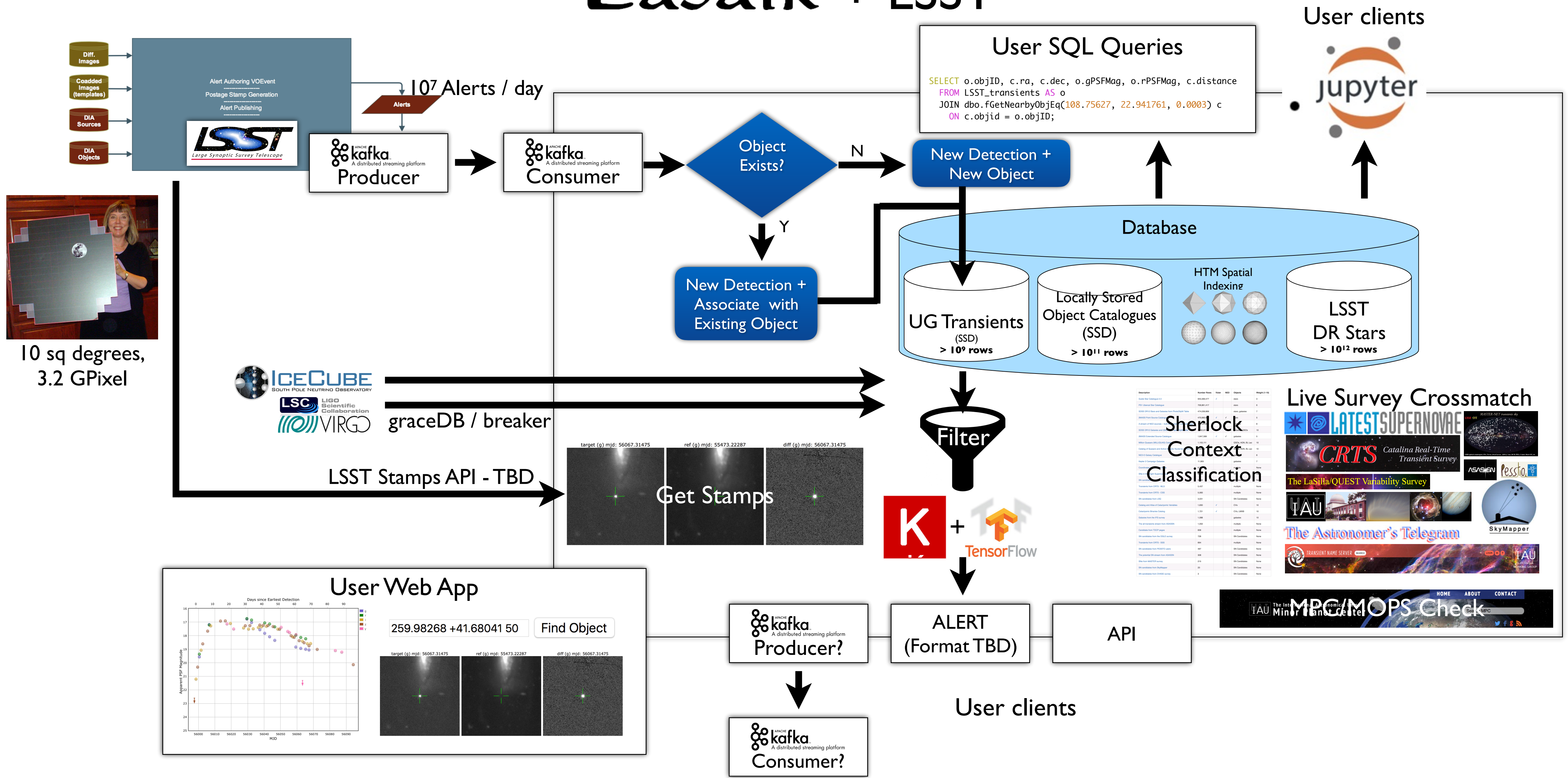
Integrate VISTA and or UKIDSS stamps

EUCLID: optical and NIR images, high-resolution stamps of transient location

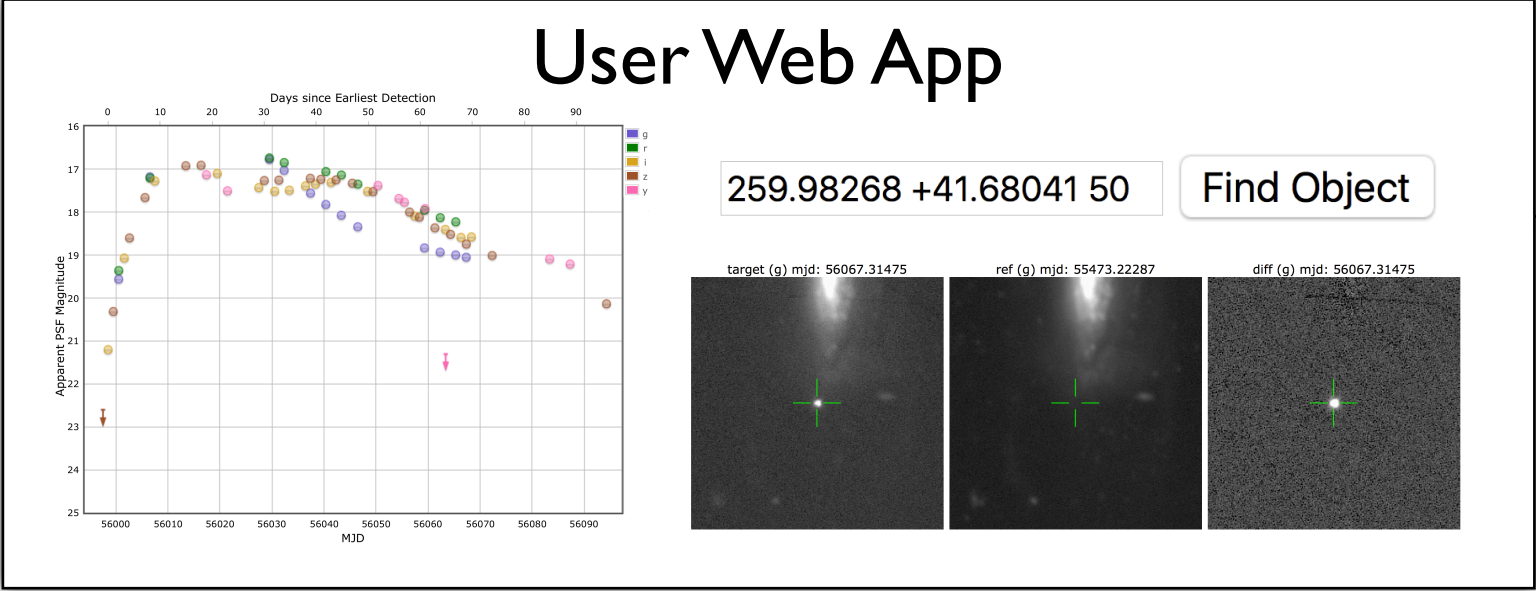
HST and Spitzer overlap. Provide postage stamp of the pre-discovery position

Store transmission characteristics of filters for mapping lightcurves

# Lasair + LSST



10 sq degrees, 3.2 GPixel



```

User SQL Queries

SELECT o.objID, c.ra, c.dec, o.gPSFMag, o.rPSFMag, c.distance
FROM LSST_transients AS o
JOIN dbo.fGetNearbyObjEq(108.75627, 22.941761, 0.0003) c
ON c.objid = o.objID;
    
```

**Sherlock Context Classification**

Description	Number Rows	Year	SED	Class	Weight (%)
Star	845,988,177	1990-2010	None	Star	99.9
Galaxy	708,981,177	1990-2010	None	Galaxy	0.1
AGN	474,000,000	1990-2010	None	AGN	0.0
Quasar	1,847,368	1990-2010	None	Quasar	0.0
Blazar	1,847,368	1990-2010	None	Blazar	0.0
Gamma-ray Burst	1,847,368	1990-2010	None	Gamma-ray Burst	0.0
Supernova	1,847,368	1990-2010	None	Supernova	0.0
Transient	1,847,368	1990-2010	None	Transient	0.0
Other	1,847,368	1990-2010	None	Other	0.0

**Live Survey Crossmatch**

- LATEST SUPERNOVAE
- CRTS: Catalina Real-Time Transient Survey
- The LaSilla/QUEST Variability Survey
- ASAS-SN
- Pessto
- TAU
- The Astronomer's Telegram
- SkyMapper
- TAU Transient Name Server
- TAU Minor Planet Center
- MPC/MOPS Check



# Lasair Next Steps

Submit formal Letter of Intent to be an LSST broker (May 15th)

Very large UK compute resource (IRIS) - hardware guaranteed (est 0.5 EB storage by end of survey and millions of hours/year CPU resource)

Certainly large enough to hold the estimated 2.2PB of alert data  
(<https://dmtn-102.lsst.io/DMTN-102.pdf>)

Lasair part of the overall U.K. plan for a full data access centre (DAC) with value added software and other data sets (Gaia, VISTA, UKIDSS)

Deploy Lasair onto the new IRIS petascale platform and scale up from ZTF to LSST, including database replication

Continue (in parallel) to explore no SQL technologies (e.g. foundationDB, Cassandra) and big data stacks (e.g. SMACK)



# Lasair Next Steps

Lightcurves – present assimilated diaSource alerts in diaObjects: providing interactive webpages (linked to database), plots, ability to select ranges, submit user added points. Previous history from Pan-STARRS, DES, Skymapper, ATLAS, CRTS, PTF/ZTF

Postage stamps (if available) – all LSST detections and most recent non-detections. Plus multi-colour images from LSST, near infra-red (VISTA/UKIDSS), H-alpha (VPHAS) and EUCLID, or HST/JWST if space based imaging is available.

Massive catalogue cross-match - with star, galaxy, AGN, x-ray, radio catalogues and provide enhanced classification (e.g. integrating machine learning) via "Sherlock"

Probabilistically classify all transients as: supernova – kilonova – GRB – Tidal Disruption Event – AGN – XRB – CV – eruption star – microlens – orphan (e.g. use of first 24-48hrs lightcurve - rapid rise/decline?)

# LASAIR Next Steps

In real-time, cross-match to all other wavelength time-domain surveys : gamma-ray, x-ray and radio (e.g. MEERKat/Thunderkat through 4pisky.org, Swift, SVOM, eRosita)

Cross match to all previously known transients: supernovae, transients, gamma ray-bursts, x-ray and radio burst sources (e.g. searching for currently unknown physical links over the time dimension)

Provide absolute mags when likely host spectroscopic (or photoZ) information is available

Multi-messenger cross-matching: 4D coincidence tag for LIGO/Virgo + IceCube

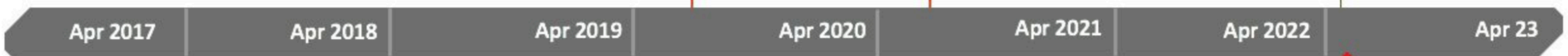
TOM outgast - especially 4MOST and SOXS

# LASAIR Current Plan

- Real-time processing of an alert stream and full functional user interaction – Pan-STARRS and ATLAS
- Fully functional database with  $10^9$  rows, real-time access and interaction updates by users
- Build 1st Generation master catalogue of all-sky sources : USNO, GSC, SDSS, NED, Veron, Milliquas, CVs, MPC
- Context and cross-matching classification code : *Sherlock V1.0*
- Machine learning code operational for real-bogus classification
- Link fully functional database to a public announcement stream
- Hardware specifications for upscale to LSST data rates



Work complete to date (Nov 2017)



Phase A Project Start

Working version of LASAIR V1.0

Release LASAIR V2.0

Release LASAIR V3.0

Start of LSST science surveys + LASAIR V4.0

Full scale operations

# LASAIR is being used

(39 ATels - including ePESSTO as of April 25 2019)

## SOAR telescope spectroscopic classification of optical transients

ATel #12508; *R. Cartier (CTIO), G. Terreran, R. Margu (CTIO)*

*on 16 Feb 2019; 20:07 U*

*Distributed as an Instant Email Notic*

*Credential Certification: Regis Cartier (rgc*

Subjects: Optical, Supernovae

 Tweet

We report the following supernova classifications. The targets were observed at the Zwicky Transient Facility (https://www.ztf.caltech.edu/; Kulkarni et al. 2018, ATel #11266) through the Lasair broker (http://lasair.roe.ac.uk/), the ESA Campaign (https://www.esa.int/ESA/ScienceData/Alerts) and DPAC (http://gsaweb.ast.cam.ac.uk/alerts), and by the ATLAS (ATLAS19dby; ATLAS19dby; ATLAS19dby) and Tonry et al. (ATel #8680). The observation was performed on February 13 at the 4.1-m SOAR Telescope equipped with the SOAR Spectrograph using the 400 lines/mm grating, and a slit width of 1.5 arcsec. The observation provided full spectral coverage from 380 nm to 775 nm with a resolution of 1.5 nm. The classification was done with SNID (Blondin & Tonry, 2007, ApJ, 666, 1024) and Gelato (Blondin & Tonry, 2007, ApJ, 666, 1024).

## FDST spectroscopic classification of SN 2019awc

ATel #12503; *C. P. Gutierrez (University of Southampton), C. Frohmaier (University of Portsmouth - ICG), T. Muller-Bravo (University of Southampton), C. Inserra (Cardiff University), J. Anderson (ESO), C. Angus (University of Southampton), R. Cartier (CTIO), T.-W. Chen (MPE), T. de Jaeger (UC Berkeley), L. Galbany (University of Pittsburg), S. Gonzalez-Gaitan (CENTRA), M. Grayling (University of Southampton), H. Kuncarayakti (University of Turku), J. Lyman (University of Warwick), A. Pastorello (INAF - Padova Astronomical Observatory) M. Pursiainen (University of Southampton), R. Roy (IUCAA), T. Schweyer (MPE), M. Smith (University of Southampton), M. Sullivan (University of Southampton), P. Wiseman (University of Southampton).*

*on 14 Feb 2019; 18:40 UT*

*Credential Certification: Claudia Gutierrez (c.p.gutierrez-avendano@soton.ac.uk)*

Subjects: Optical, Supernovae, Transient

 Tweet

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

Survey Name | IAU Name | RA (J2000) | Dec (J2000) | Disc. Date

ATLAS19dby | SN2019awc | 04:23:29.34 | -15:46:01.0 | 20190213

The observations were performed on 2019-02-13 using SPRAT (Piascik et al 2014) on the Liverpool

# LASAIR Summary

First prototype version is running. See <https://lasair.roe.ac.uk>

User created queries always welcomed

LoI will be submitted

Scaling up to LSST has begun

Other data storage technologies being explored

[lasair-help@lists.roe.ac.uk](mailto:lasair-help@lists.roe.ac.uk)  
<https://github.com/lsst-uk/lasair/issues>