

# Lasair

A future LSST Community Broker  
(but now a prototype with ZTF)

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

# Summary

- Object page with Sherlock and TNS
- SQL-based alert filters
- Filter can be static or streaming
- Watchlists and watchmaps
- Lightcurve Features to build filters
- Lasair API with throttling
- Annotations
- Mining Lasair
- Rich documentation and video tutorials

Search by ZTF or TNS name

Lasair

Search

su

Log in

News

Warning: Lasair will not be available starting Monday 18th September, for 5 days, due to planned maintenance by a service provider. There will be no ingestion of Lasair alerts, website, or API access.

- Filters
- Watchlists
- Watchmaps
- Annotators
- Status
- Quick Start
- About
- FAQ
- Schema Browser
- Contact

Contextual documentation

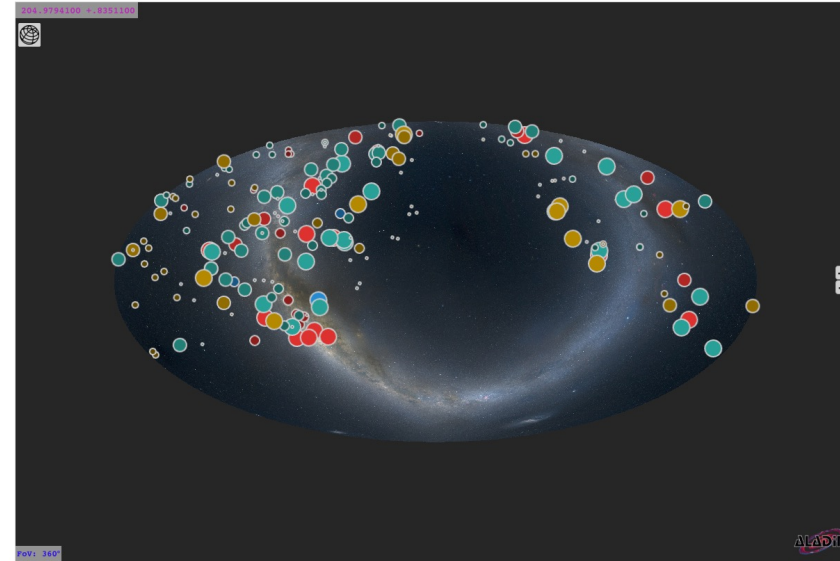
**Watchlists**

Transients matched within a given radius of a pre-defined catalogue of sky-positions.

[Learn more](#)

### Latest ZTF Transient Alerts Map

This skymap shows the most recent, bright (<17 Mag) ZTF transient detections, coloured by their predicted type. The longer ago the transient was last detected, the smaller and fainter its marker. Click on a markers for information about an object, and then on the 'ZTF' transient ID for full information.



● Possible Supernova ● Nuclear Transient ● Cataclysmic Variable ● Active Galaxy

Mellinger color optical survey - Copyright 2000-2017 Axel Mellinger. All rights reserved.

Help

Documentation and questions

### Latest ZTF Transient Alerts Table

Export

A list of transients found in the map above

Search table...

objectId	ra mean	dec mean	g mag	r mag	last detected	predicted type
ZTF23abbzycc	350.67016	58.200035	18.523	15.555	3.8	SN
ZTF23abbxvco	358.39279	59.429584	16.683	16.378	3.9	SN
ZTF23abaxkwq	329.37134	41.250268	16.968	16.406	3.9	SN
ZTF23abawvxd	118.80461	12.576606		16.979	0.7	SN
ZTF23abawgqs	107.64151	50.119418	15.985	15.978	5.8	SN

Some new transients Display or Table

Table Export as JSON or CSV

# Object page

basic info

go deeper

TNS

Aladinlite  
alert is red square  
more layers

go deeper

**ZTF20abrbeie**  
318.451728, 27.430696

Discovery Date: 2020-07-16 10:18:31 UTC  
Discovery MJD: 59046.43  
Disc r-Mag: 20.77±0.25

Latest Date: 2023-09-04 04:22:31 UTC  
Latest MJD: 60191.18  
Latest r-Mag: 19.87±0.15

Transient Name Server **AGN AT2021lwx**

The transient was discovered on *13th April 2021 at 10:55:51* (MJD 59317.46) by ZTF as ZTF20abrbeie with a discovery magnitude of  $r = 18.05$ . It was subsequently classified as a *AGN* at  $z = 0.995$ .

Sherlock Contextual Classification  
Prediction: **ORPHAN**

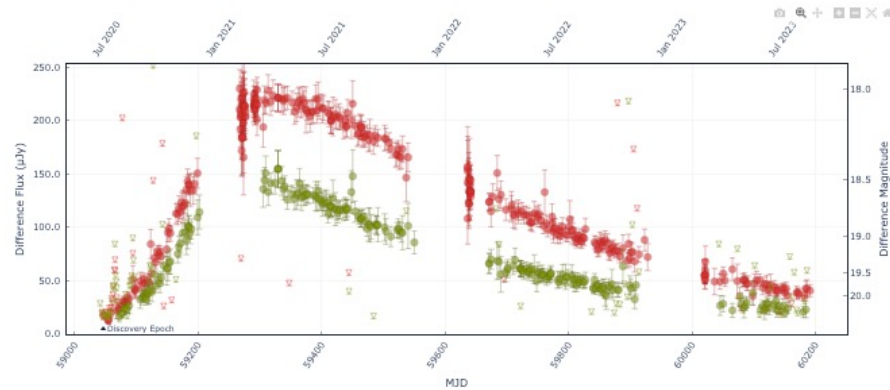
The transient is not obviously associated with any catalogued galaxy nor is it coincident with a known stellar source.

Sherlock (sky context)

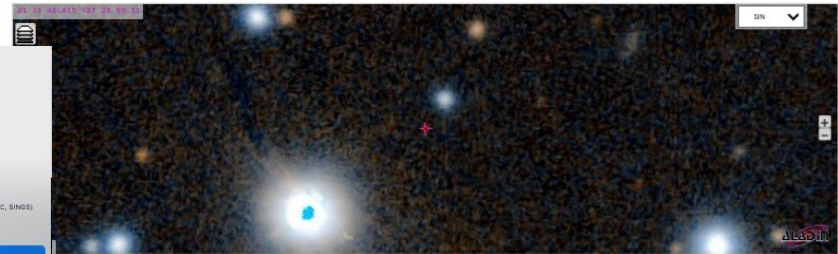
Difference Image Lightcurve

Access the data from this plot in the *ZTF Alert Packet Data* table below.

Light curve, flux and mag



- 2MASS colored
- AllWISE color
- DECaPS DR1 color
- DSS colored
- DSS2 Red (7-8)
- Density map for Data Release (350galaxy2)
- Fermi color
- GALEXDR\_L\_NUV
- GLIMPSE80
- Hepha
- IRAC color (1,2,4 - GLIMPSE, SAGE, SAGE-SMC, SINGS)
- IRIS colored
- Mellinger colored
- Pan-STARRS DR1 color
- Pan-STARRS DR1 g
- SDSS9 band-g
- SDSS9 colored
- VTSS-Ha
- XMM-PS colored



Recent Image Stamps

target

reference

difference

Cutout images

External Resources

- [Simbad](#)
- [NED](#)
- [DECaLS Sky Browser](#)
- [Galactic Extinction](#)

External resources

ZTF Alert Packet Data

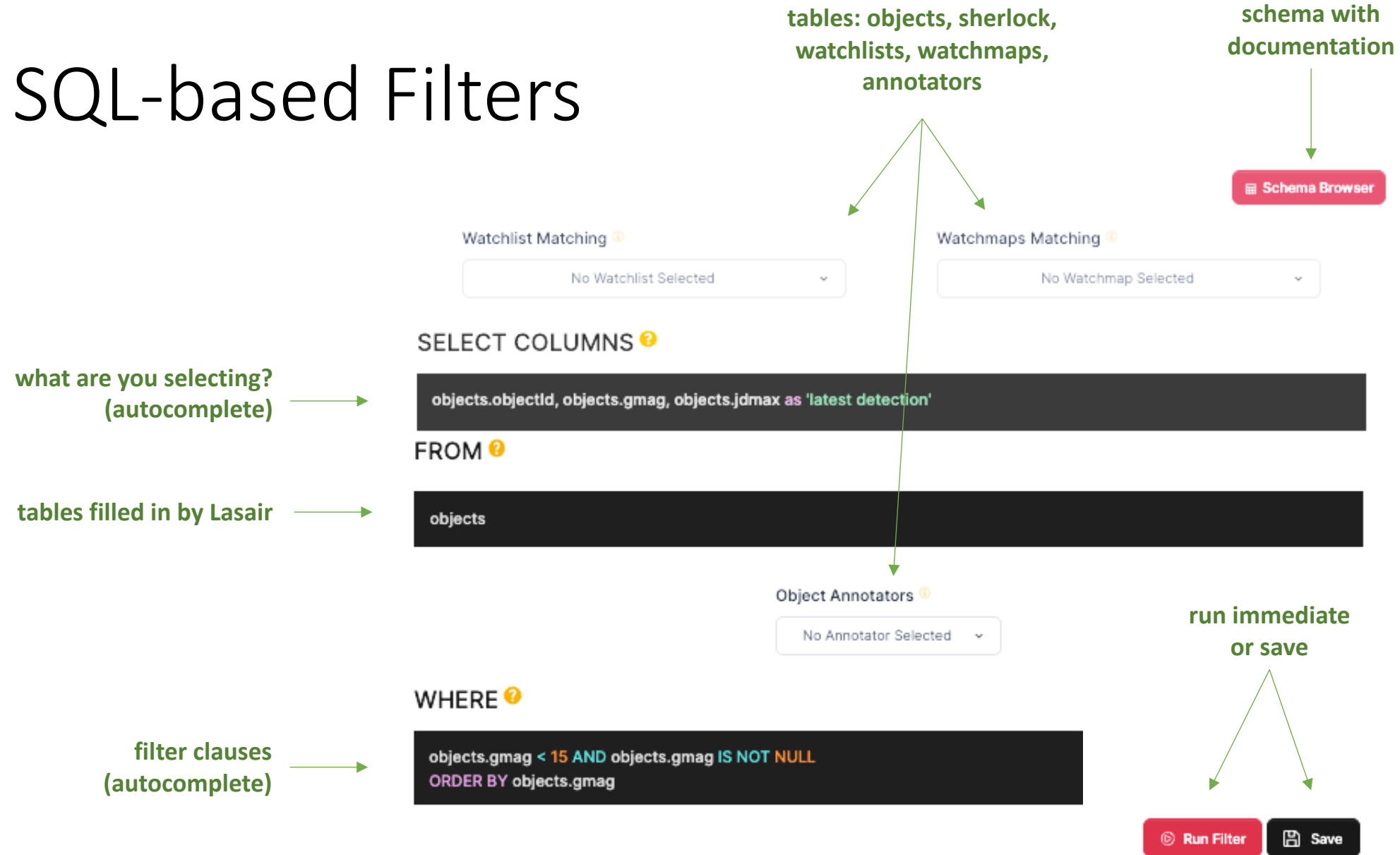
[Export](#)

Search table...

MJD	UTC	Filter	magpsf	difference flux status	images	alert packet
60191.182315	2023-09-04 04:22:31	r	19.874 ± 0.150	+ve	target ref diff	data
60186.253333	2023-08-30 06:04:47	r	19.829 ± 0.211	+ve	target ref diff	data
60186.194618		g	19.507	limit		
60184.411250	2023-08-28 09:52:11	g	20.492 ± 0.353	+ve	target ref diff	data
60184.315799	2023-08-28 07:34:44	r	19.821 ± 0.175	+ve	target ref diff	data

All the detections and cutouts

# SQL-based Filters



# Save Filter: Muted or Active?

Active means it runs in real time as alerts come in!

Muted just means its stored in your account

### Filter Settings

Update your filter settings

**Name**

**Description**

**Streaming**

How would you like to be notified of new alerts

**public**

Submit filter to the public gallery

Can share filters,  
watchlists, watchmaps,  
if you like

### Streaming

How would you like to be notified of new alert

- muted
- email stream (daily)
- kafka stream

# Watchlist

A personal list of interesting sources

Active watchlist means catch associated alerts



## 'BL Lac for TeV' Watchlist Associations

BL Lac candidates for TeV observations (Massaro+, 2013) The watchlist contains 42 sources with a default association radius of 5.0 arcsec. The watchlist is active.

Duplicate Export

## Watchlist Results

Export

Transient objects located within an association radius of a source in the 'BL Lac for TeV' watchlist.

Search table...

Catalogue ID	separation (arcsec)	cone_id	objectId	ramean	decmean	rmag	gmag
1ES 1101-232	0.776	76160	ZTF23aabpgop	165.90697	-23.492015	18.783	19.108
Markarian 180	1.956	76162	ZTF23aabglsz	174.10889	70.157167	17.100	
B3 2247+381	0.184	76179	ZTF22aaexcvb	342.52397	38.410310	17.724	18.296
Markarian 180	0.416	76162	ZTF21abxnjl	174.11019	70.157637	17.193	17.228
H 1426+428	0.164	76168	ZTF21aaqpvak	217.13595	42.672540	18.871	19.036

5 max: unlimited  
4 Separated-Values  
3 Decimal  
2 ID  
6 Submit  
1 Reset All

See dox for how to build from Vizier



File format  
RA, Dec, Name <radius>

```
003.4835000|-18.9018056|SHBL J001355.9-185406
008.3931667|-19.3591389|KUV 00311-1938
008.9692500|+59.8345278|1ES 0033+595
028.1650000|+01.7881667|RGB J0152+017
035.6650000|+43.0355000|3C 66A
038.2025000|+20.2881389|1ES 0229+200
045.8603750|-24.1198333|PKS 0301-243
049.9658333|+18.7596111|RBS 0413
057.3465833|-11.9908889|1ES 0347-121
064.2186667|+01.0899722|1ES 0414+009
072.3528750|-43.8358056|PKS 0447-439
076.9840000|+67.6234167|1ES 0502+675
087.6600417|+22.2712222|PKS 0548-222
```

# Watchmap

A subset of the sky



Active watchmap means catch associated alerts

 **'SDSS' Watchmap Associations** 

SDSS footprint The watchmap is active. 



 **Watchmap Results** 

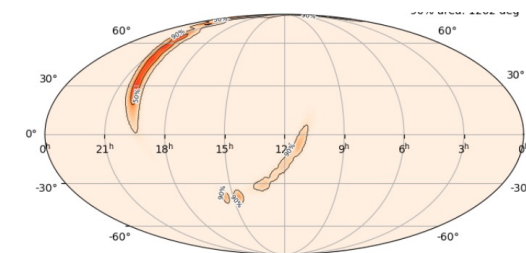
A list of objects located within the 'SDSS' watchmap

objectId	ra_mean	dec_mean	rmag	gmag	last detected (days ago)
ZTF17aaajpmb	29.34368	-5.748947	16.611	16.398	4.0
ZTF17aaajpfy	16.89485	-7.024004	17.457	18.149	0.1
ZTF17aaajdpo	125.04217	26.719001	18.184		3.9
ZTF17aaajbjc	123.90868	55.559184	15.663		4.9
ZTF17aaajbit	115.27263	37.446849	17.199		4.0
ZTF17aaajbif	112.84887	37.521048	19.012		4.0
ZTF17aaaiywi	107.65307	13.556505	14.719		5.0
ZTF17aaaiyuy	108.02116	12.655774	18.411		5.0

# Watchmaps are based on MOC



- Software is at [MOCpy](#)
- Code to [create a MOC from a polygon](#)
- Easy to make MOC from LIGO skymap





# Sherlock

Classifies by sky position



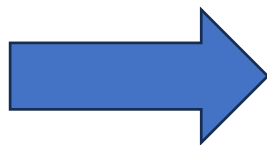
Sherlock Contextual Classification ⓘ

Prediction: **Supernova**

The transient is possibly associated with *134652602229491416*; an  $r=19.08$  mag galaxy found in the PS1 catalogue. Its located 2.68" N, 2.44" W from the galaxy centre.

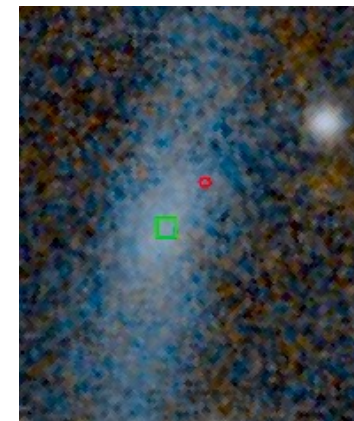
## Catalogues searched by Sherlock

- Gaia catalogues
- Pan-STARRS catalogues
- SDSS DR12
- GSC
- 2MASS
- Million Quasars Catalog
- Veron-Cett AGN Catalogue
- Downes Catalog of CVs
- Ritter Cataclysmic Binaries Catalog
- GLADE Galaxy Catalogue v2.3
- NED-D Galaxy Catalogue v13.1
- etc etc



## Classifications

- **Variable Star (VS)**
- **Cataclysmic Variable (CV)**
- **Bright Star (BS)**
- **Active Galactic Nucleus (AGN)**
- **Nuclear Transient (NT)** core of a galaxy
- **Supernova (SN)** near galaxy but not NT
- **Orphan** not matched



Talk by Dave Young

# Rich Filter

Join with sherlock, TNS, watchlist, watchmap, annotations

Example: TDE galaxies in SDSS active in last month

Watchlist Matching ⌵  
E+A galaxies (mrcholl)

Watchmaps Matching ⌵  
SDSS

**SELECT COLUMNS** ?  
objects.objectId, watchlist\_hits.name

**FROM** ?  
objects, 'E+A galaxies' as watchlist\_hits, SDSS (watchmap)

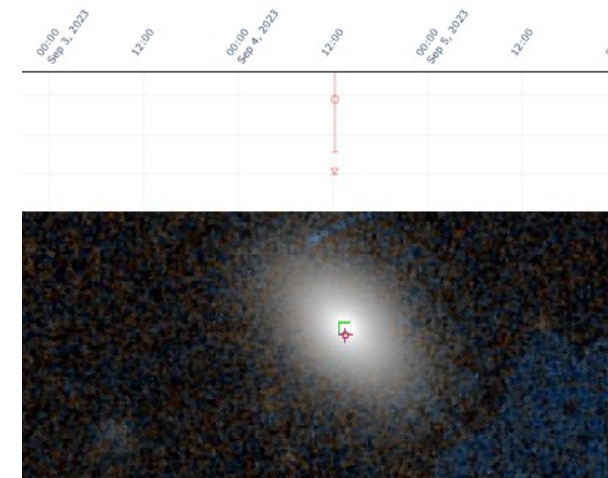
**WHERE** ?  
objects.jdmax > jdnow() - 30

**User Input**

**Generated automatically**

**User Input**

🔄 Run Filter 💾 Save



## Filter Results

objectId	name
ZTF23abawwaa	1237667211578769408
ZTF23abatklm	1237665442601435392
ZTF19abuoqzz	127953398696730064
ZTF19aabybwz	1237654385731698688
ZTF18adalgnn	143322227888669344
ZTF18abtmitt	1237663782602801408
ZTF18abtgung	1237657584949460992
ZTF18aarmxfg	1237661851483242752
ZTF18abtgung	1237657584949460992
ZTF18aarmxfg	1237661851483242752

# Lightcurve Features

Proposed for LSST  
NOT on ZTF system

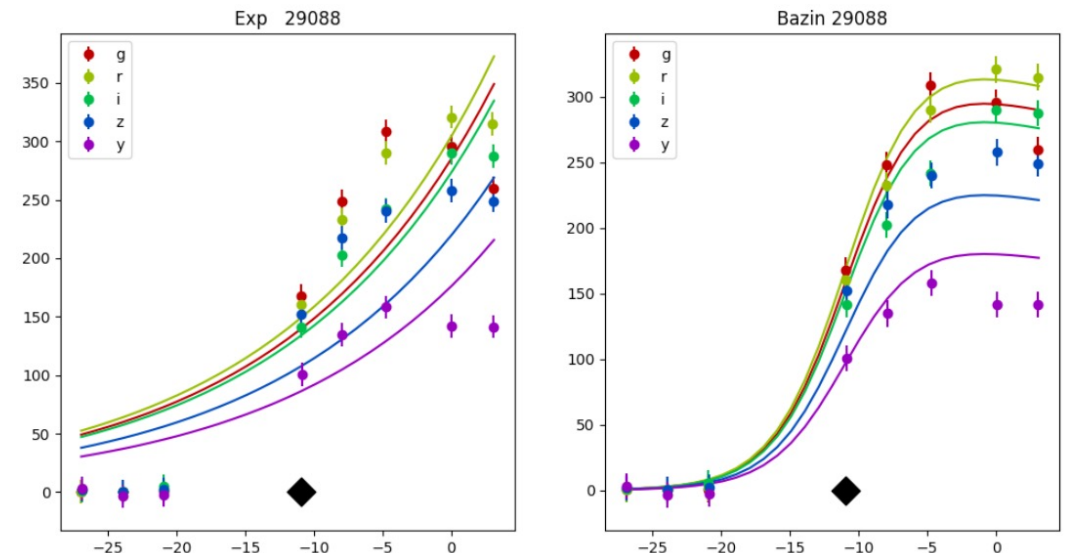


## Lasair added value for explosive transients

- Simple statistics min/mean/max/ndata 6 bands
  - Times of first and last diaSource
  - Latest flux in 6 bands
- Sherlock: distance in Mpc if available
- fluxJump
  - How many sigma above previous level
- Linear magnitude fit 6 bands
- BazinExpBlackBody
  - 2D time-wavelength surface
  - Bazin or Exp least residual
- Fastfinder
  - Incline/decline in 6 bands

## From Rubin

- Big set of features for periodic sources
- Set of features for stochastic sources



# Lasair API

Enabling mining and annotation

```
pip install lasair
```

*Talk by Ken Smith*

**cone**

cone search on all the objects in the Lasair database

**query**

SQL SELECT query on the Lasair database

**objects**

machine-readable version of the object web page

**lightcurves**

simple lightcurves for a number of objects

**annotate**

add annotation to Lasair object

**sherlock/objects**

returns Sherlock information about a list of named objects

**sherlock/position**

returns Sherlock information about a sky position

# Annotations

Add your classification to Lasair objects

Ask a Lasair team member to build your space

You need your API token

```
{  
  "lsst-g": {  
    "absolute_peak_mag_val": -20.687,  
    "absolute_peak_mag_err": 1.933,  
    "overall_incline_rate_val": 0.011,  
    "overall_incline_rate_err": 0.021  
  }  
}
```

**No schema but can be queried!**

**objectId**: the Lasair object being annotated

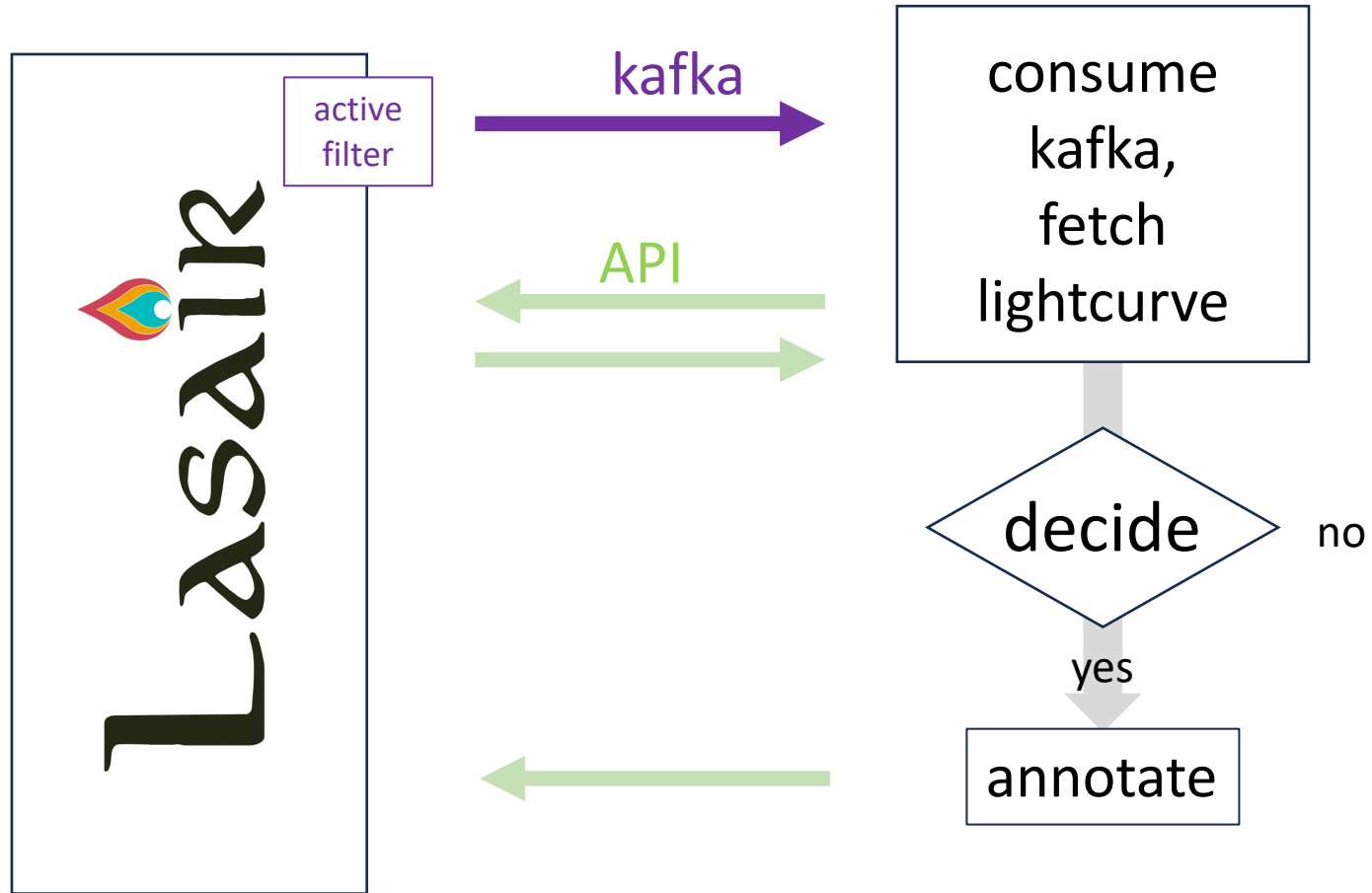
**classification**: a short string drawn from a fixed vocabulary, eg "kilonova".

**explanation**: a natural language explanation of the classification, eg "probable kilonova but could also be supernova"

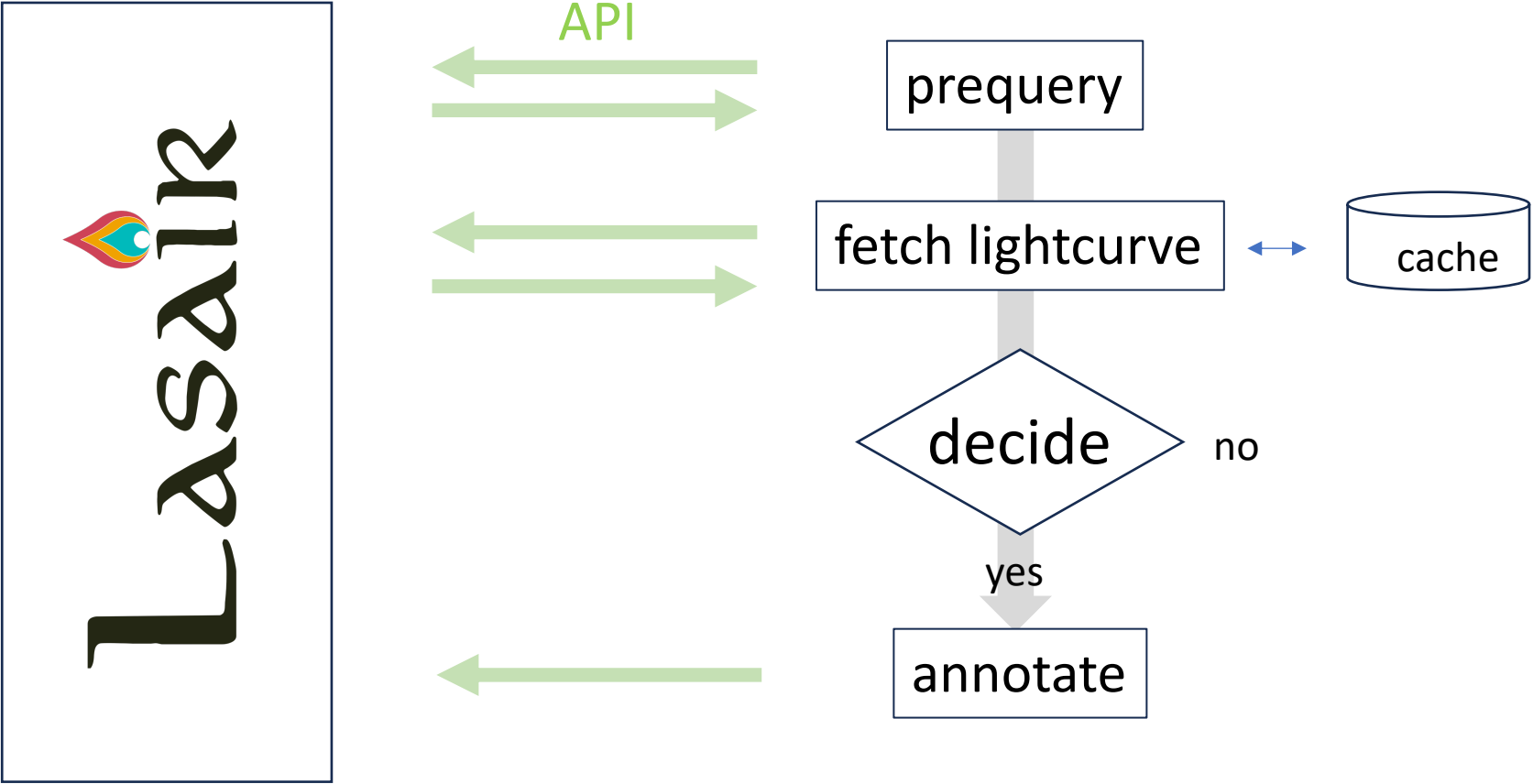
**classjson**: the annotation information expressed as a JSON dictionary



# Real-time Annotation

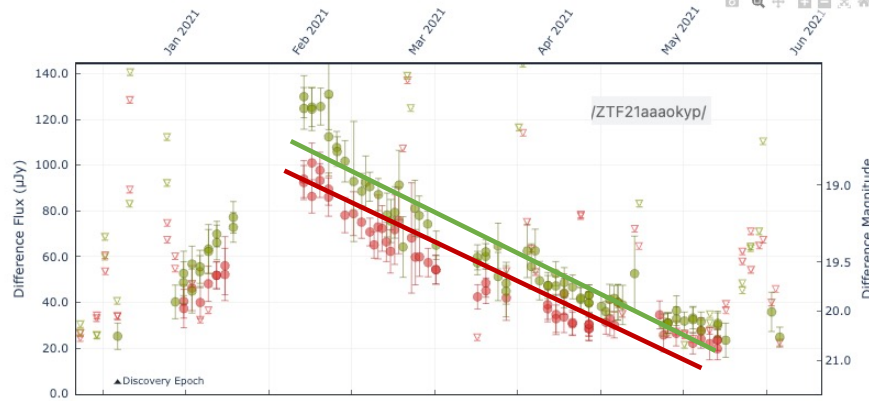
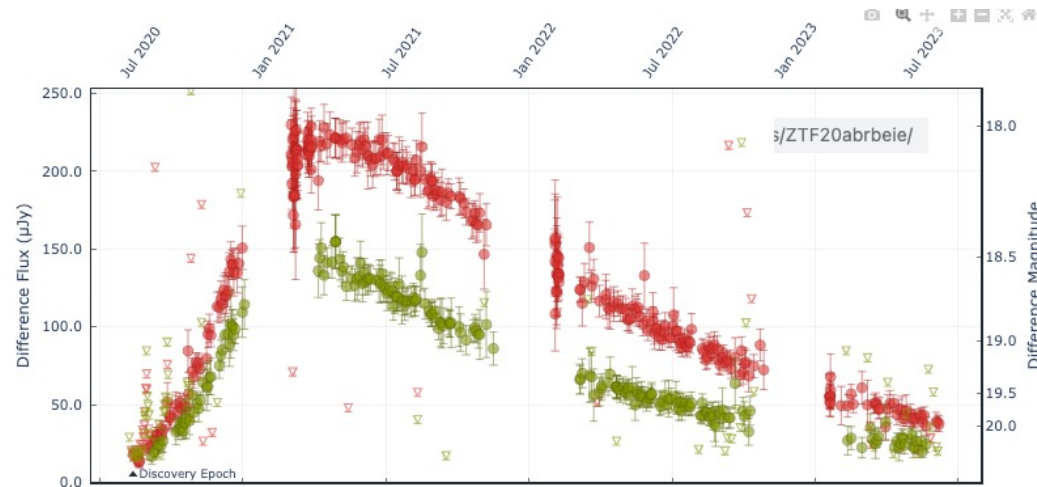


# Mining Lasair

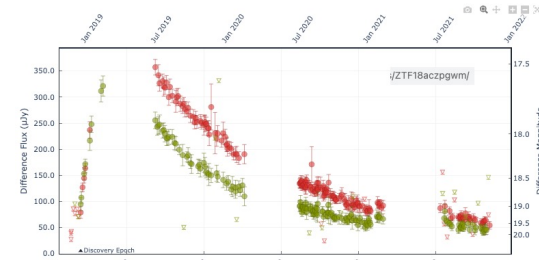
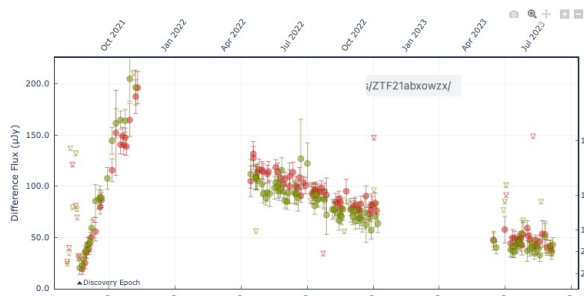


# SlowFinder

Mining Lasair to find more slow faders with Wiseman et. al.



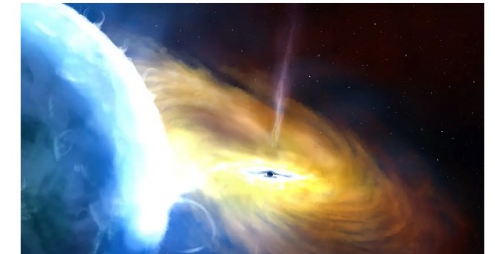
post peak linear fit



## The Biggest Explosion in the Cosmos Just Keeps Going

For three years, telescopes have monitored “one of the most luminous” events ever: a supermassive black hole consuming a gigantic cloud of interstellar gas.

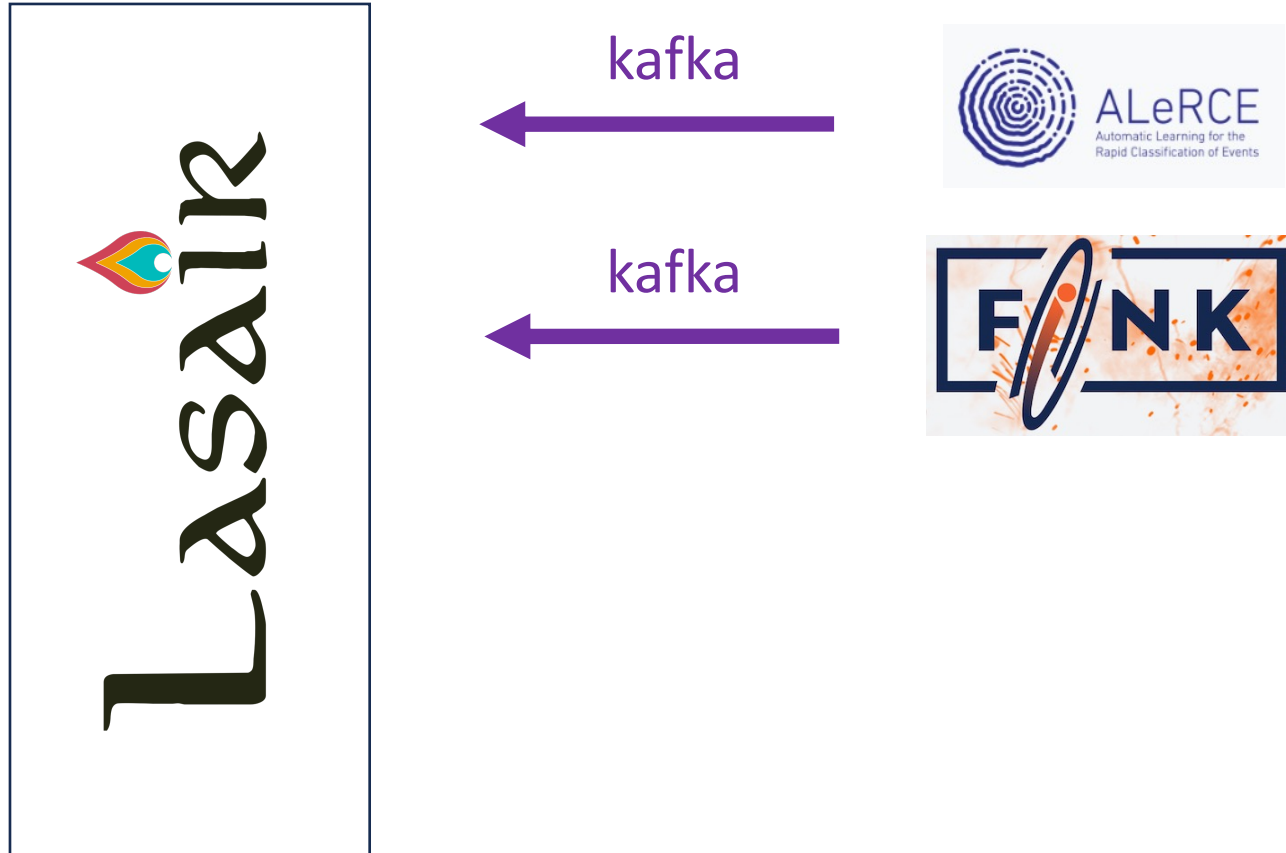
Give this article



Talk by Phil Wiseman



# Annotations from other brokers with permission



# Selecting on annotation detail

Alerce lightcurve classifier finds SLSN

## SELECT COLUMNS ?

```
objects.objectId,  
JSON_EXTRACT(alerce_lc.classdict, '$.SLSN') as SLSN
```

## FROM ?

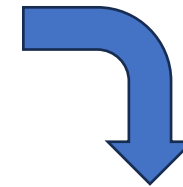
```
objects, alerce_lc (annotator)
```

Object Annotators ⓘ

alerce\_lc ▼

## WHERE ?

```
objects.idmax > idnow()-7  
AND JSON_EXTRACT(alerce_lc.classdict, '$.SLSN') > 0.05
```



From Gaia transients 27/1/2023  
Alerce SLSN = 0.349  
Sherlock says AGN from WISEA ugh

[ZTF22abfnjrg](#)



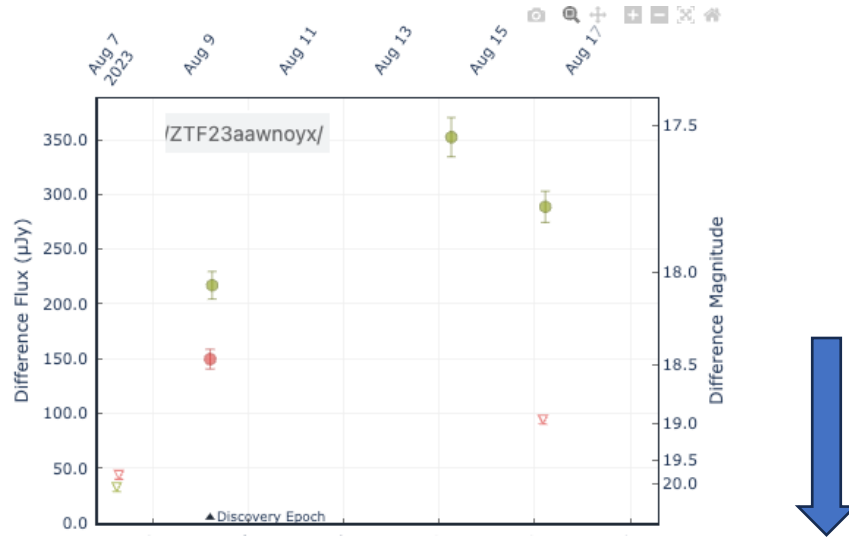
**ZTF22abfnjrg**

# FastFinder

A Lasair annotator from M. Fulton

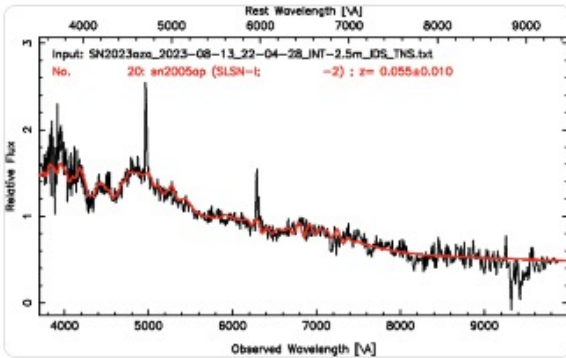
Now with a slackbot and discussion channel

Talk by Michael Fulton



Michael Fulton 4:26 PM  
@Matt, I get a really strong fit to the SLSN-I 2005ap for 2023ozo. Strange as this object is fast evolving!

Screenshot 2023-08-14 at 16.25.46.png



A screenshot of the FastFinder Slack channel interface. The left sidebar shows navigation options like 'Upgrade Plan', 'Threads', 'Direct messages', 'Mentions & reactions', 'Drafts & sent', 'Canvases', 'Slack Connect', 'Files', and 'More'. The main area shows a list of alerts under the heading '# alerts'. The alerts list includes:

- ZTF23aawbyyt (AT 2023opo) -- The lightcurve is fast fading in one or more filters. The latest colour prediction is  $g-r = -0.19 \pm 0.05$ . There is considerable dust reddening ( $A_v = 0.81$ ) along the line of sight to the transient.
- ZTF23aawbyyt (AT 2023opo) -- The lightcurve is fast fading in one or more filters. The latest colour prediction is  $g-r = -0.11 \pm 3.46$ . There is considerable dust reddening ( $A_v = 0.9$ ) along the line of sight to the transient.
- ZTF23aaxcmzs (AT 2023pgw) -- The lightcurve is fast fading in one or more filters. The latest colour prediction is  $g-r = -0.81 \pm 0.18$ .
- ZTF23aaxffza (AT 2023pjz) -- The lightcurve is fast rising and fast fading in one or more filters. The latest colour prediction is  $g-r = -0.38 \pm 0.07$ .
- ZTF23aawizyr (AT 2023oqs) -- The lightcurve is fast fading in one or more filters. The latest colour prediction is  $g-r = -0.23 \pm 1.5$ . There is considerable dust reddening ( $A_v = 2.91$ ) along the line of sight to the transient.

At the bottom, a note states: 'Only certain people can post in this channel. Learn more'.

# Rich Documentation

Deep-linked from Lasair web

How-to Video

## START

[Quick Start](#)

[Videos](#)

## ABOUT LASAIR

[About Lasair](#)

[The Lasair approach](#)

[How Lasair Works](#)

[ZTF and LSST](#)

[What Lasair is not](#)

[Scientific goals of Lasair](#)

## CONCEPTS

[Objects and Sources](#)

[Lightcurve](#)

[Sky Context](#)

[Queries and Filters](#)

[Coding with Lasair](#)

[Lasair's Added Value](#)

[Annotations](#)

## CORE FUNCTIONS

[Sky Search](#)

[Sherlock \(Sky Context\)](#)

[Make a Lasair Filter](#)

[Watchlists](#)

[Watchmaps \(Sky Regions\)](#)

[Lasair API and Client](#)

[Python Notebooks](#)

[Alert Streams](#)

[Making an Annotator](#)

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[Lasair account](#)

[Questions and Answers](#)

[Contact Us](#)

[Lasair Ingestion Status](#)

[Acknowledgements](#)



<https://lasair.readthedocs.io>

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