



@ZTF\_ANOMALY\_BOT

# ANOMALY DETECTION IN FINK

---

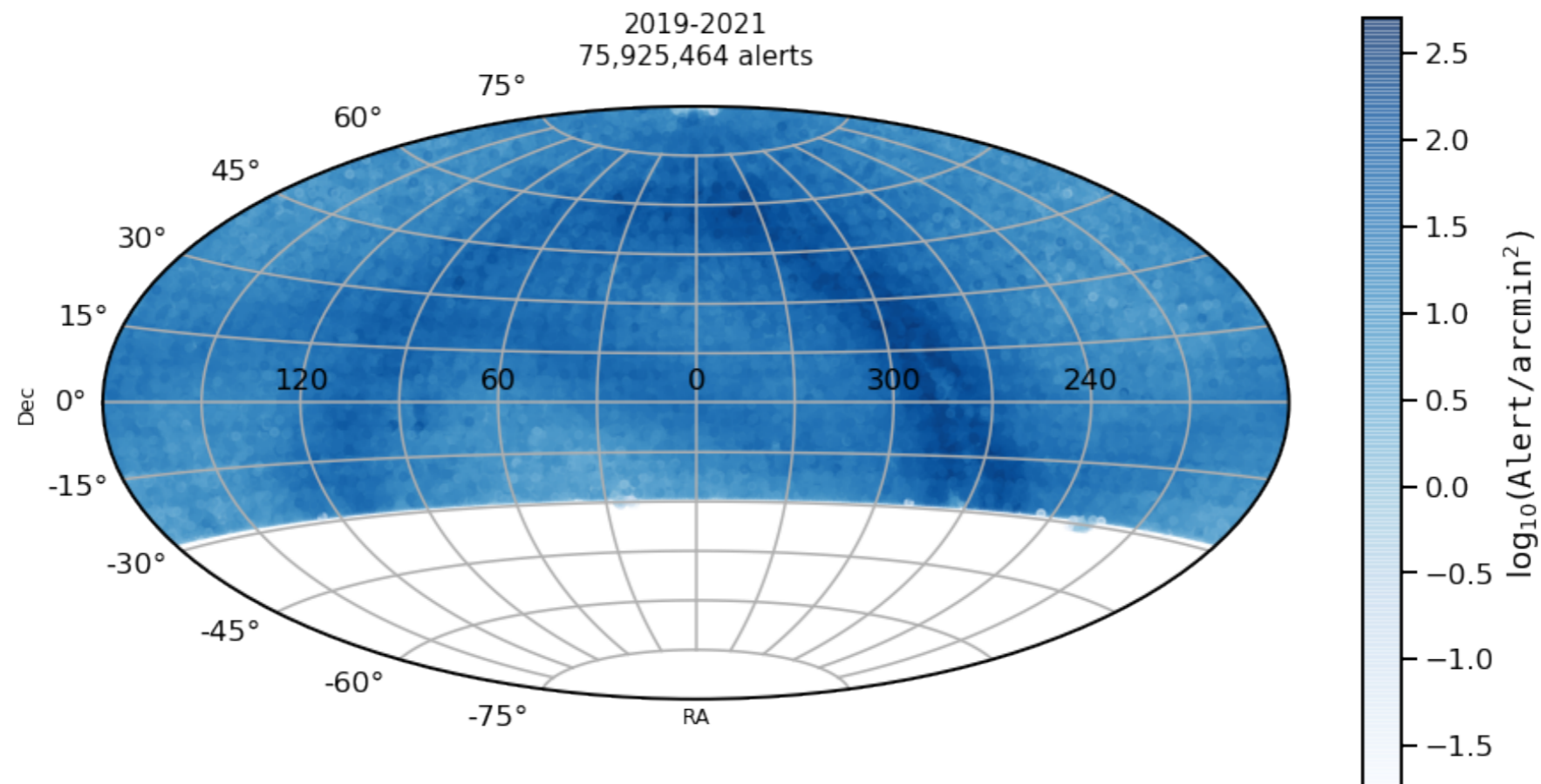
Maria Pruzhinskaya

on behalf of the Fink team

Laboratoire de Physique de Clermont

Fink Collaboration Meeting  
January 2024

## ZTF/FINK STATISTICS



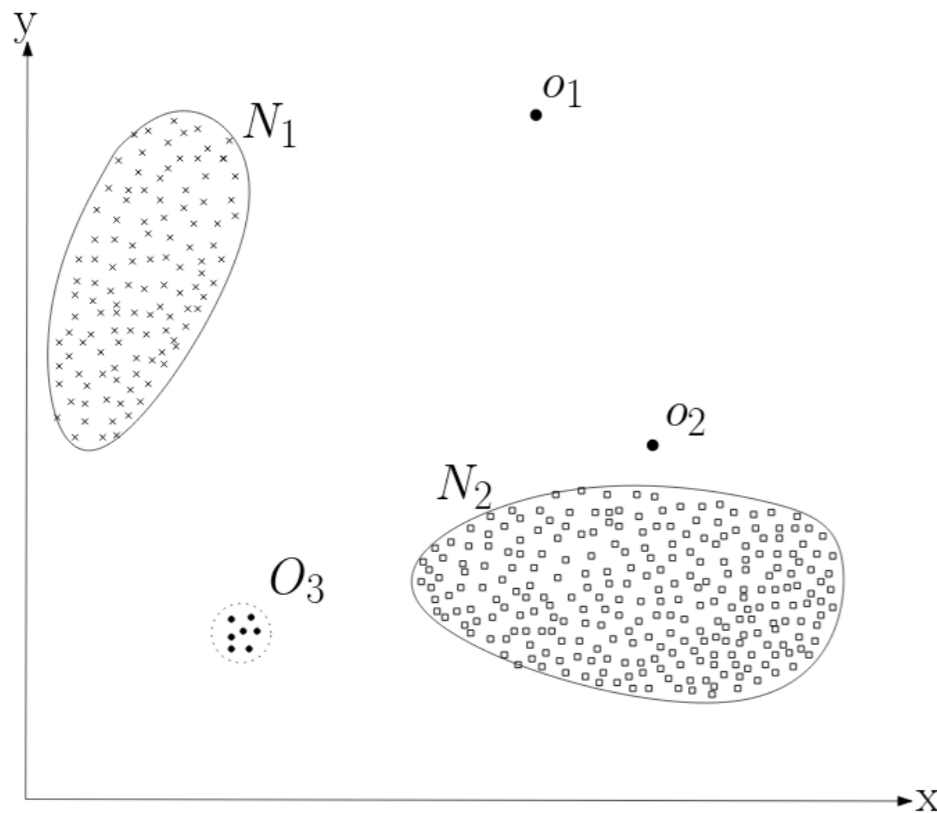
- ▶ 170 million alerts received, 114 million processed (<https://fink-portal.org/stats>)
- ▶ Typical nightly rates (200,000 alerts)



# WHAT DO YOU MEAN BY ANOMALY?

## MACHINE DEFINITION

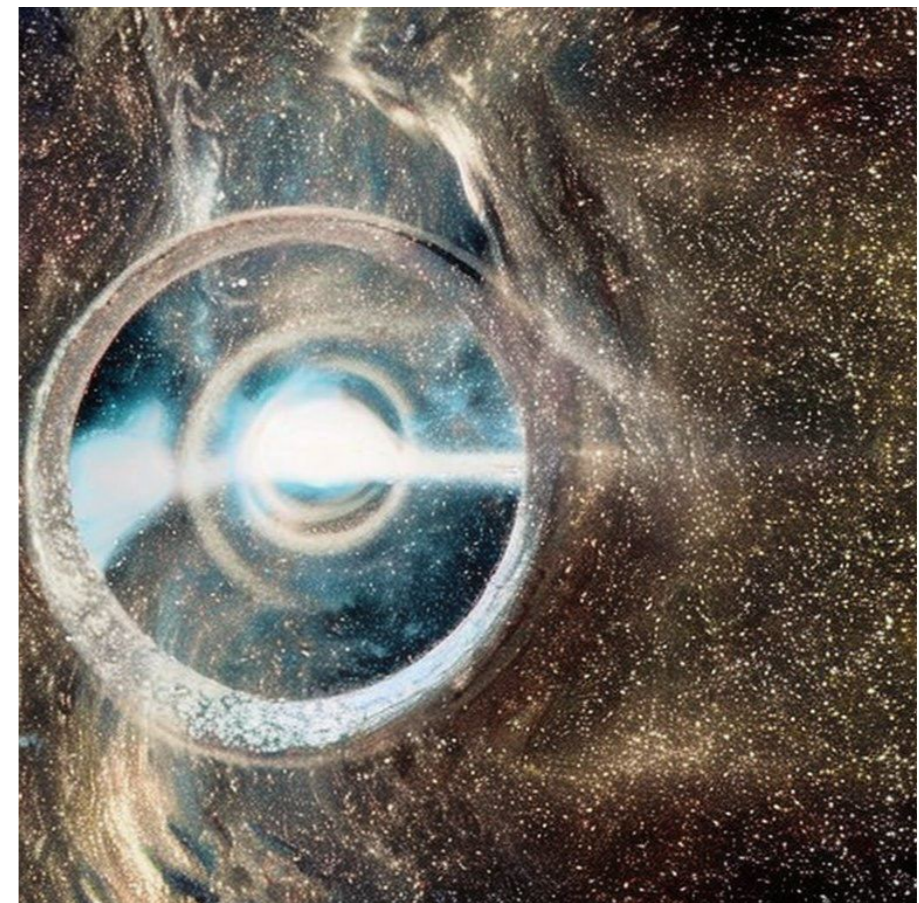
- ▶ Objects with high anomaly score  $\rightarrow$  not necessarily interesting for the expert



Chandola V., et al. 2009

## HUMAN DEFINITION

- ▶ Astrophysically interesting anomalies  $\rightarrow$  depends on the task

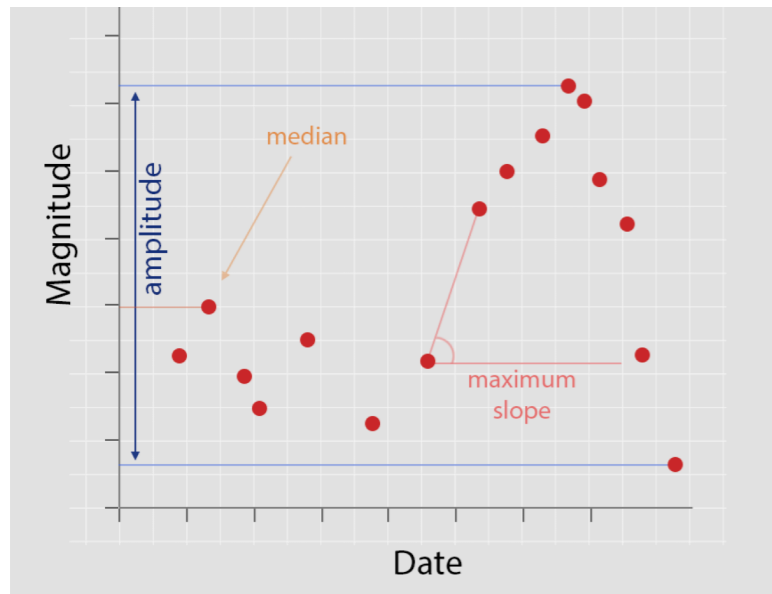




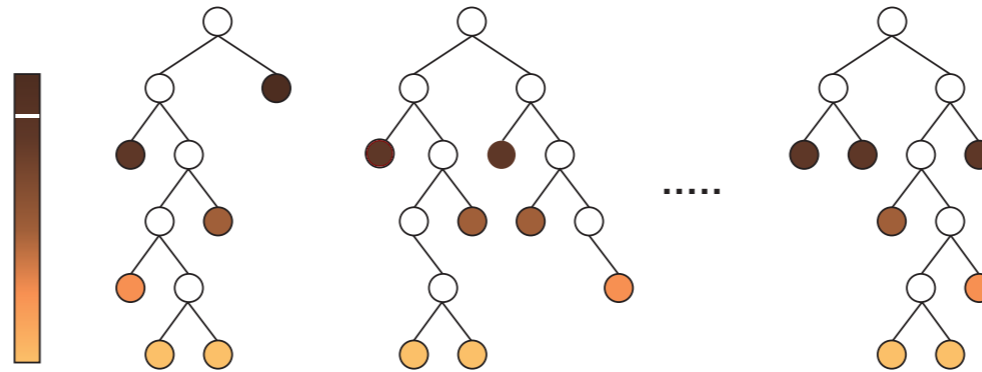


# FINK ANOMALY DETECTION

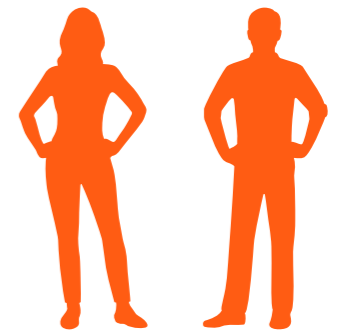
## ad features module




## anomaly detection module



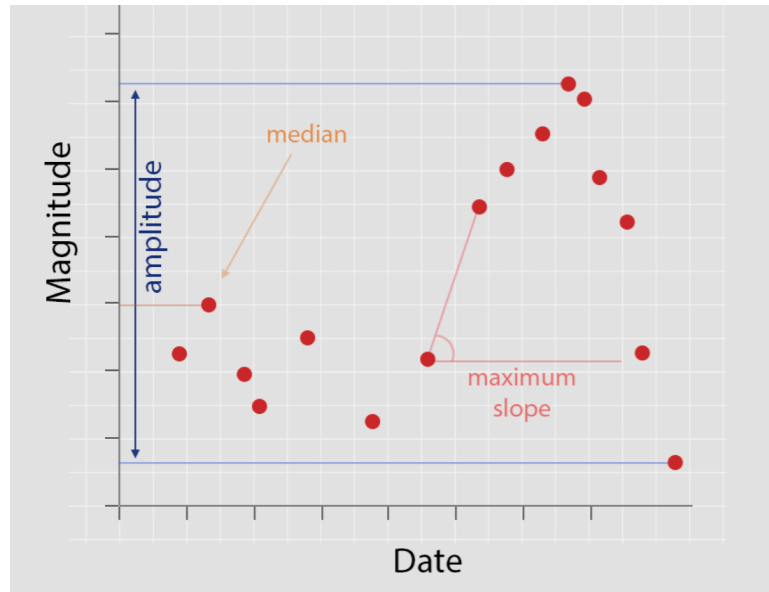
## anomaly notification module



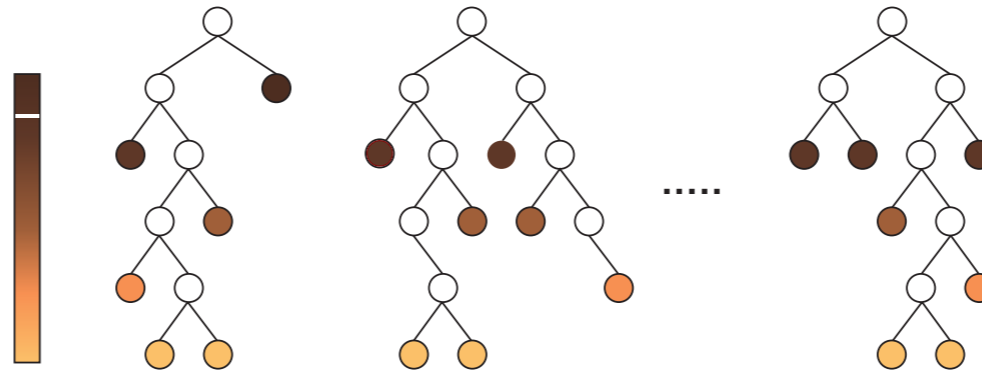
- ▶ 22 features (Malanchev et al., 2021  **SNAD**)
- ▶ ztf\_g and ztf\_r passbands

# FINK ANOMALY DETECTION

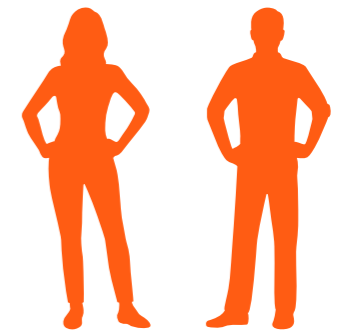
## ad features module



## anomaly detection module



## anomaly notification module

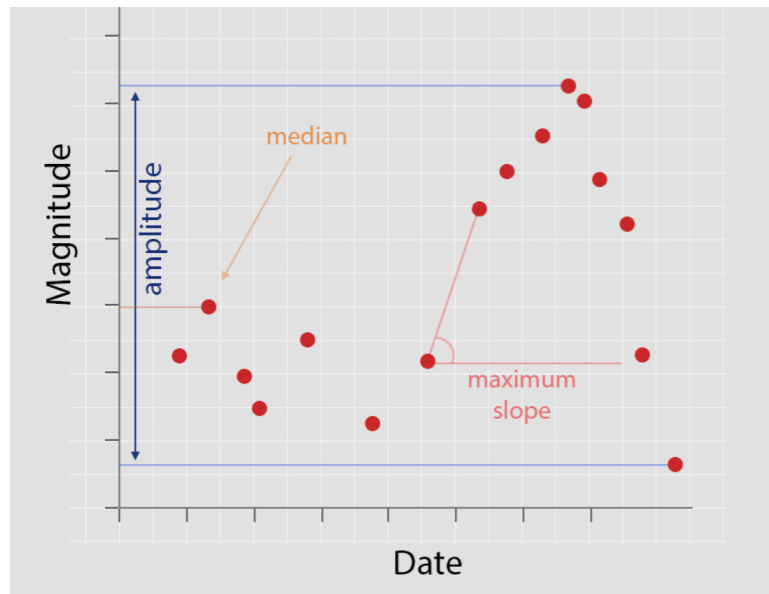


- ▶ Isolation forest applied to the LC features in both bands
- ▶ Resulting anomaly scores is averaged

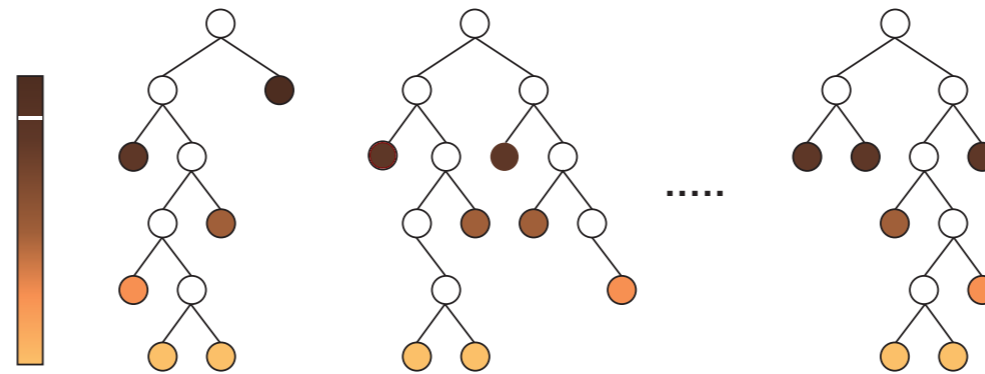


# FINK ANOMALY DETECTION

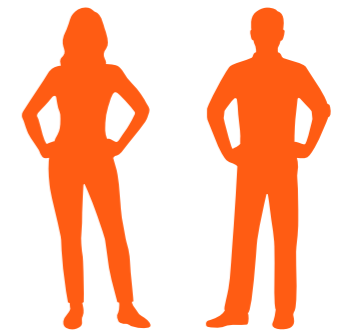
## ad features module



## anomaly detection module



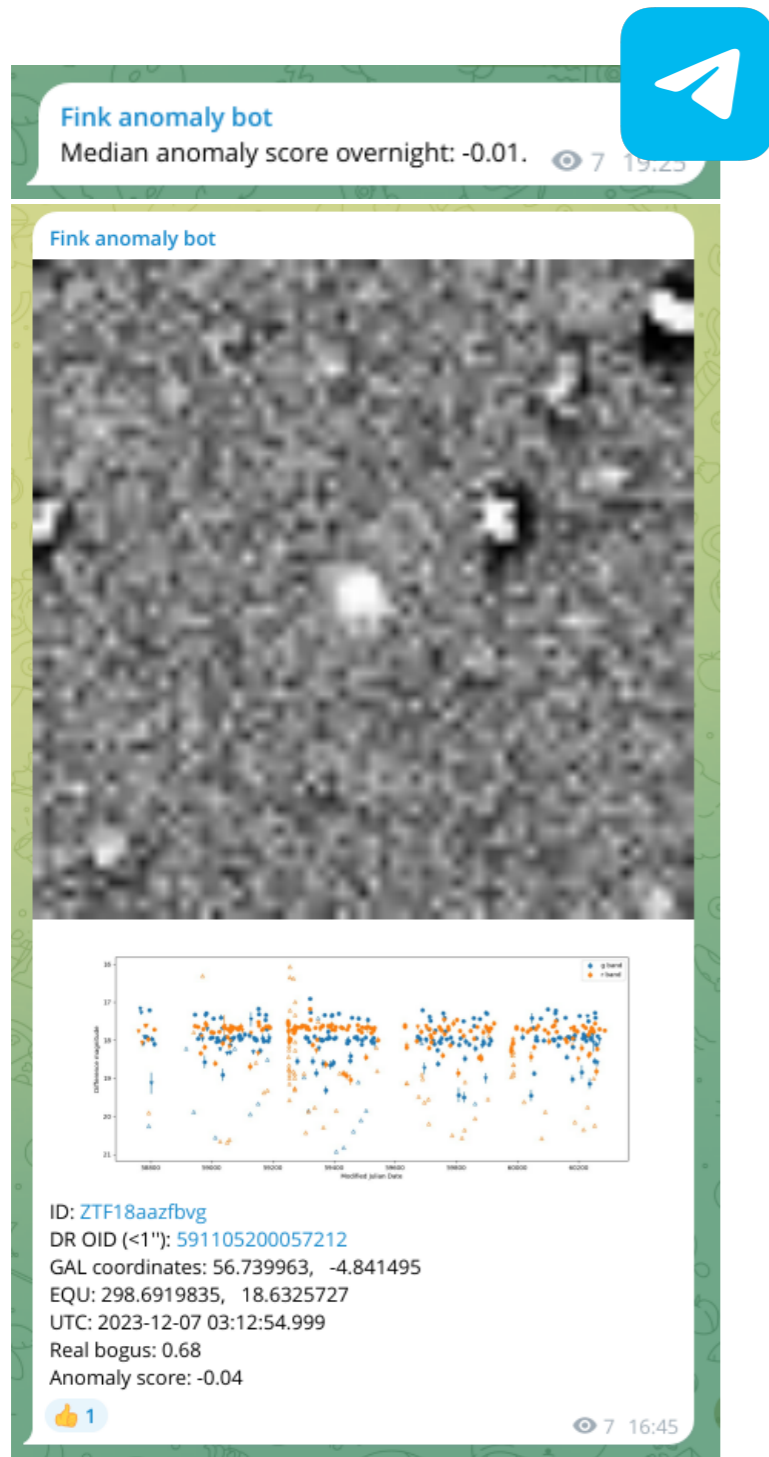
## anomaly notification module



- ▶ Domain expert analysis to discover and to debug

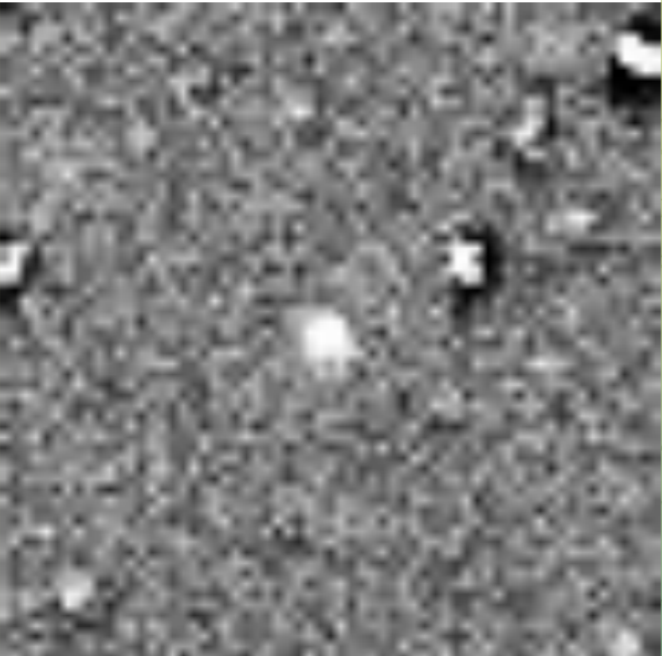
# SLACK AND TELEGRAM BOTS

- ▶ TOP-10 anomalies each night

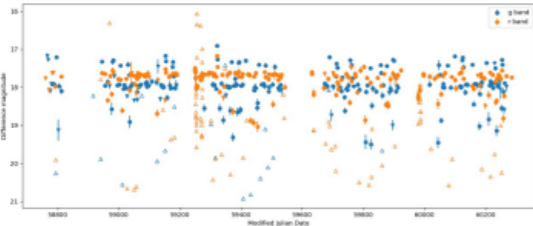


Fink anomaly bot  
Median anomaly score overnight: -0.01. 7 19:25

Fink anomaly bot



ID: ZTF18aazfbvg  
DR OID (<1"): 591105200057212  
GAL coordinates: 56.739963, -4.841495  
EQU: 298.6919835, 18.6325727  
UTC: 2023-12-07 03:12:54.999  
Real bogus: 0.68  
Anomaly score: -0.04



1 7 16:45



Thread # fink\_alert



**Powerful app** APP 20 hours ago

ID: ZTF23aaijdl

GAL coordinates: 57.907693, 49.801733

UTC: 2023-05-01 09:50:46.999

Real bogus: 0.88

Anomaly score: -0.63



1 reply



**Maria** 10 minutes ago

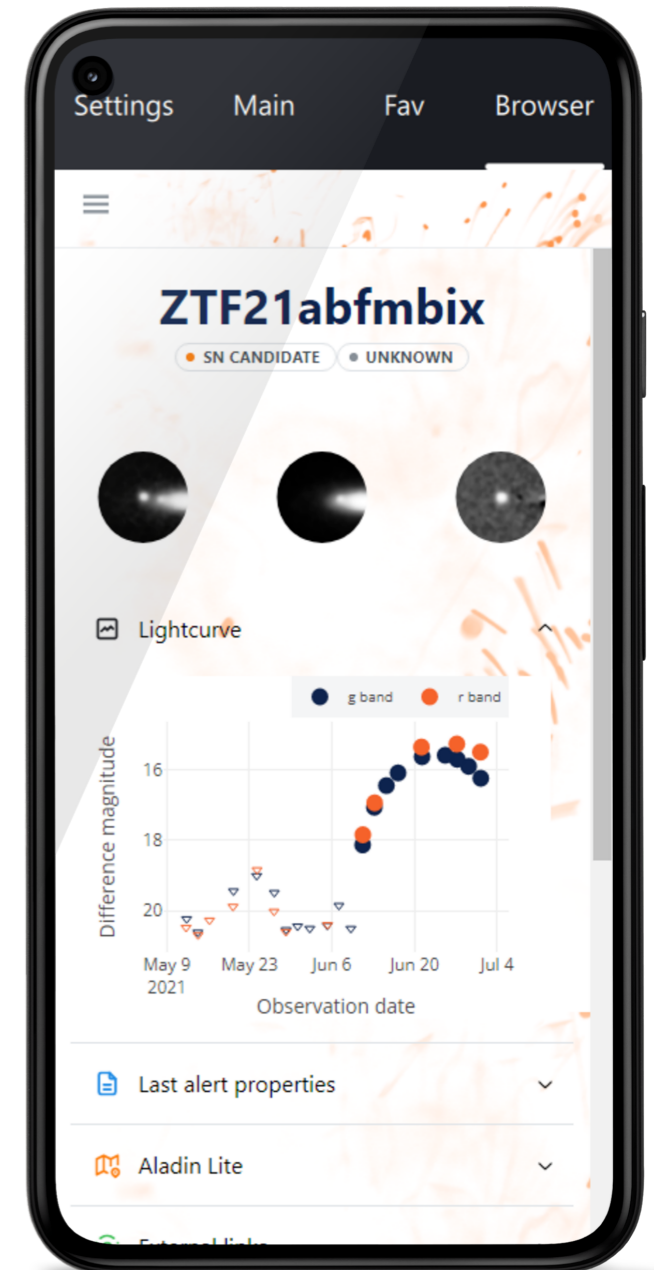
check it later – could be a rising  
supernova (edited)

B I

Reply...

Also send to # fink\_alert


+ Aa




Settings Main Fav Browser

## ZTF21abfmbix

SN CANDIDATE UNKNOWN



Lightcurve



g band r band

16  
18  
20  
22

May 9 2021 May 23 Jun 6 Jun 20 Jul 4

Observation date

Last alert properties

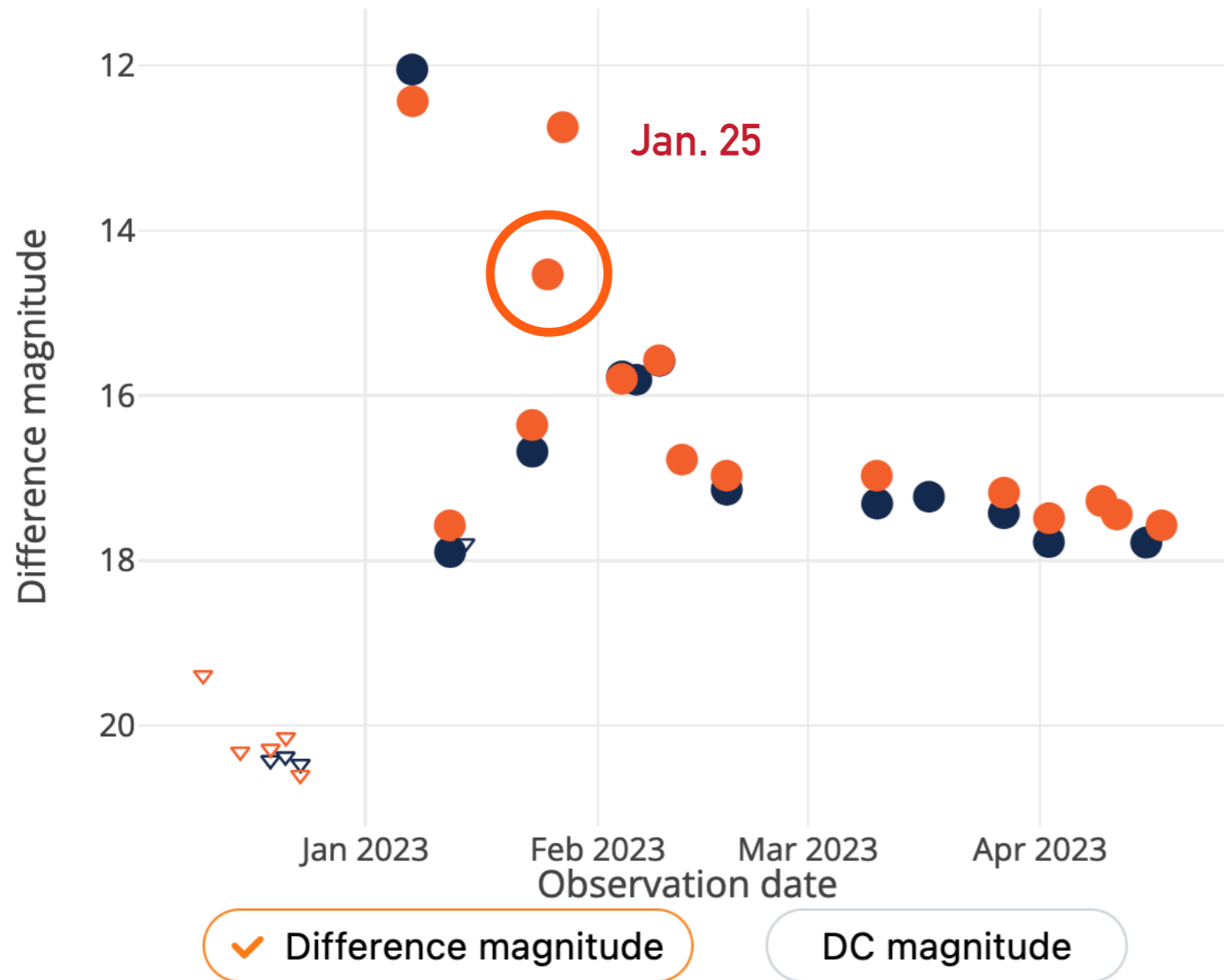
Aladin Lite

Credit: Timofey Pshenichniy

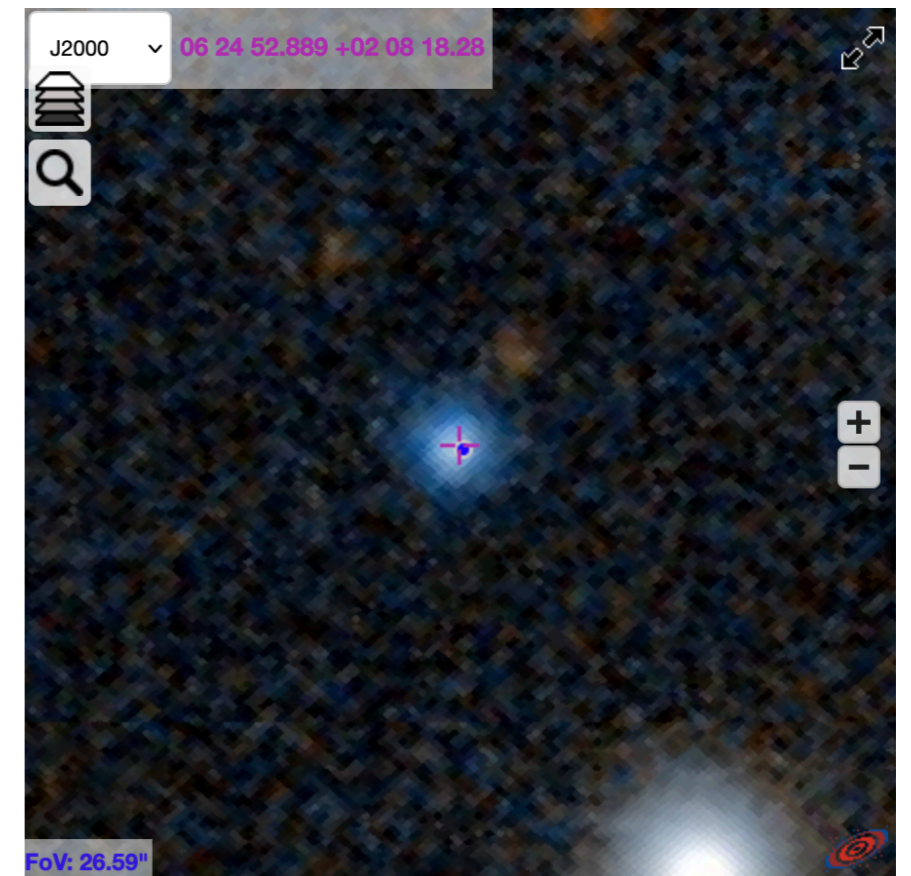
# FIRST NIGHT – FIRST ANOMALY

<https://fink-portal.org/ZTF23aaaatwl>

● g band ● r band



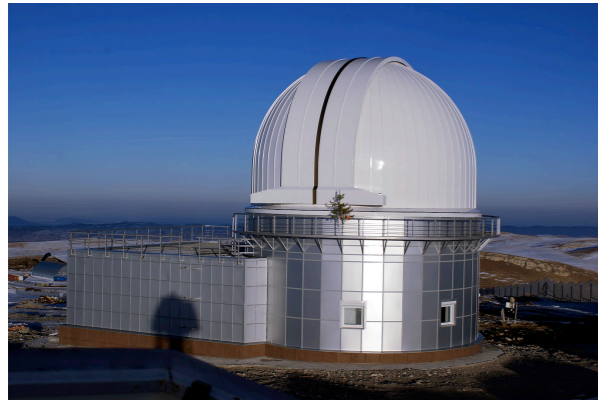
- ▶ ASASSN-23ac/PNV  
J06245297+0208207
- ▶ Simbad: WD candidate



REPORTED IN TNS AS AT 2023AWT



# FOLLOW-UP OBSERVATIONS



2.5M KGO



9.2M SALT

**AT 2023AWT**

~40 spectra

~hundreds observations in B,V,R,r

AM CVn of WZ Sge-type (only 3 known)



0.2M FOSC-ES32  
[2023TNSCR.231....1B]



0.6M KGO

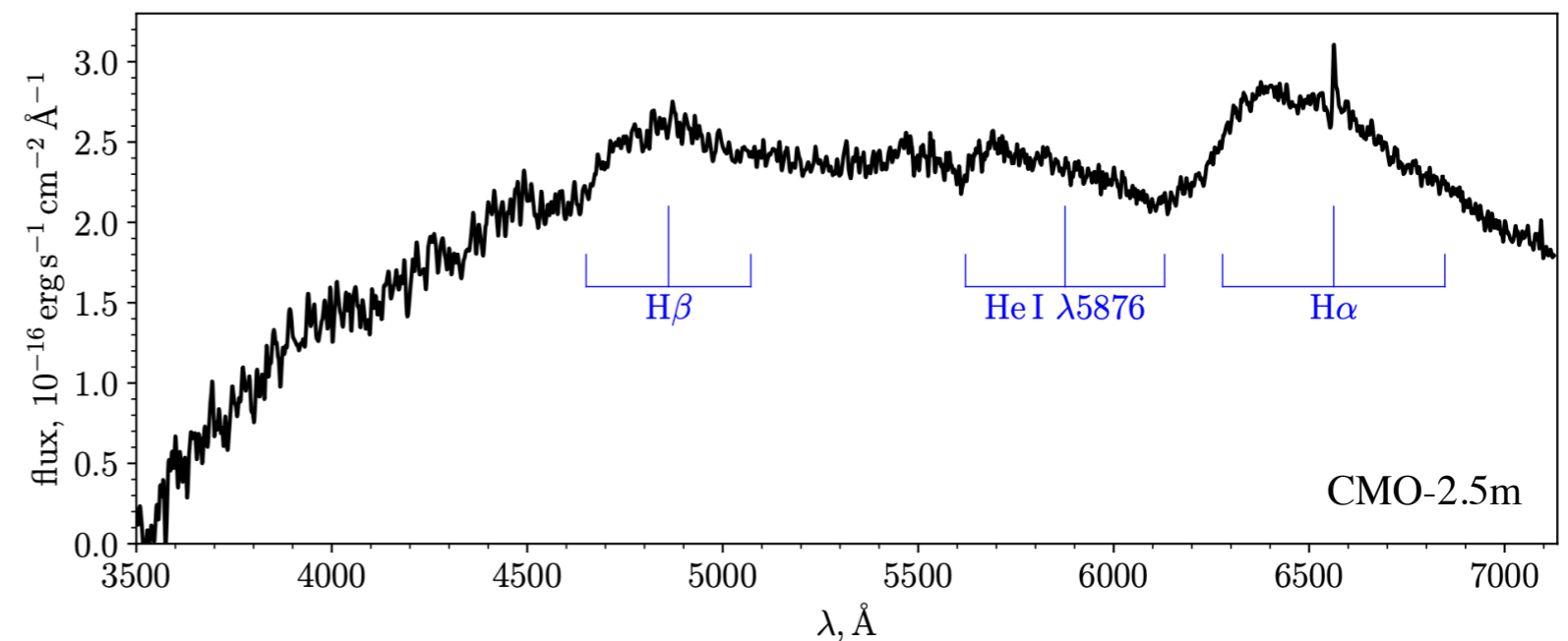
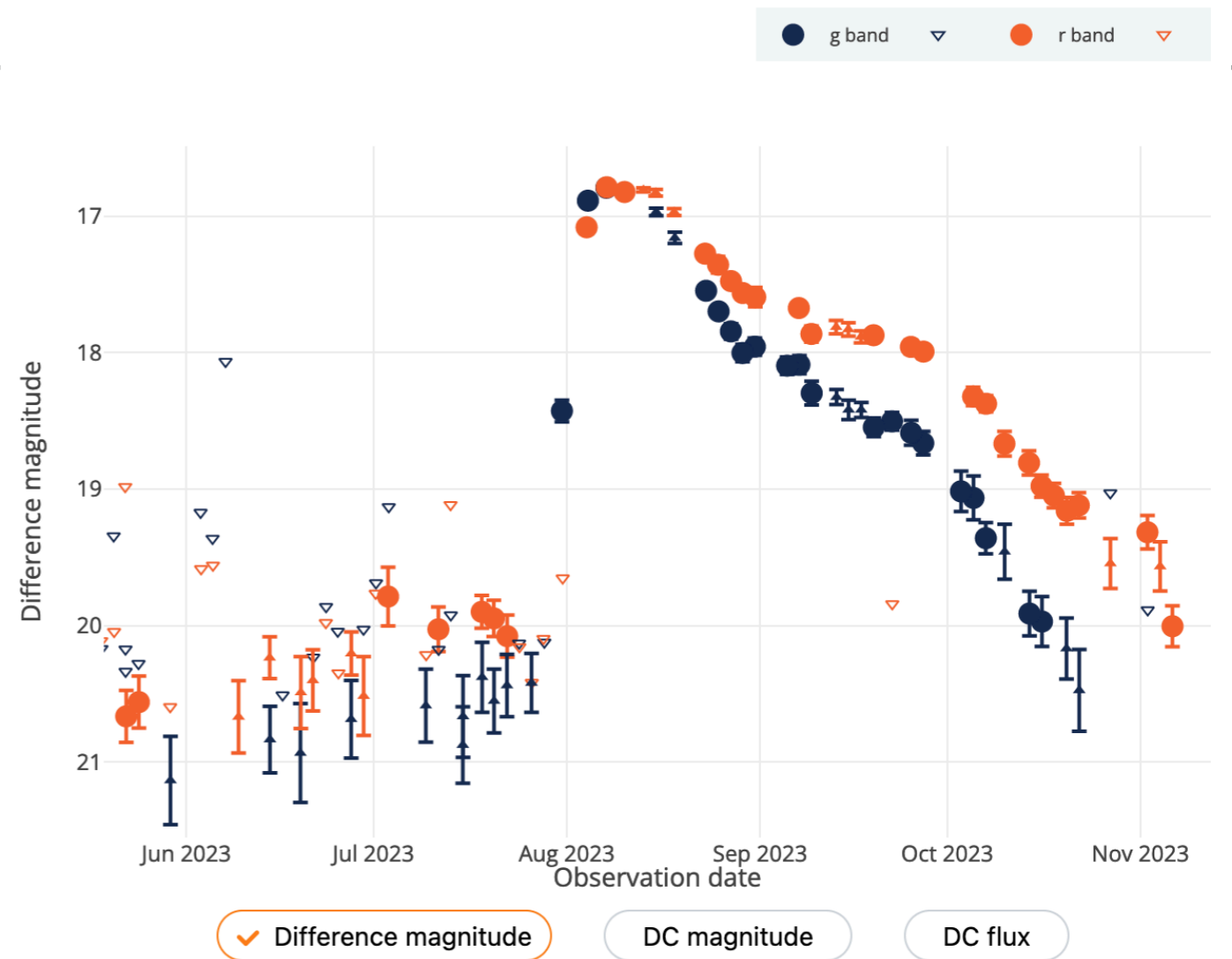


0.25M FRAM-ORM

# RARE SUPERNOVA

<https://fink-portal.org/ZTF23aalftv>

- ▶ Featureless spectra
- ▶ Low-surface-brightness galaxy
- ▶ Redshift undefined
- ▶ Pre-cursor activity



Credit: A. Dodin, A. Belinskii

# CATAclysmic Variables



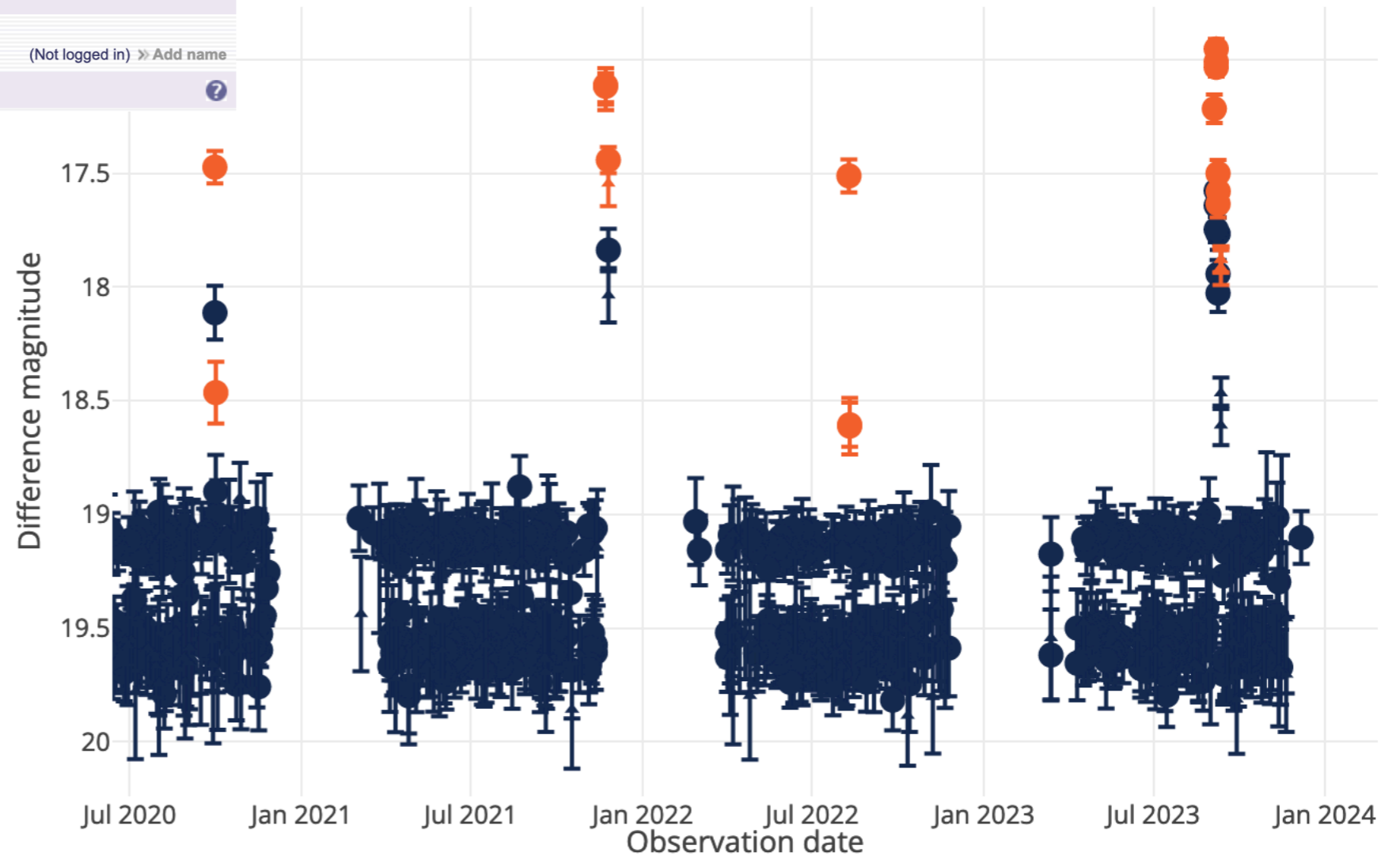
## Latest Details

Log in to retrieve additional aliases from SIMBAD.

Name	<b>ZTF18aayoyvo</b>
AAVSO UID	000-BPS-433 (No observations)
Constellation	Cygnus <a href="#">» Sequence</a>
J2000.0	20 34 40.21 +50 48 00.8 (308.66754 +50.80022) <a href="#">» Search nearby</a>
B1950.0	20 33 10.42 +50 37 37.1
Galactic coord.	88.017 +6.227
Other names (Internal only)	Fink J203440.21+504800.8 (Not logged in) <a href="#">» Add name</a>
Variability type	UG

<https://fink-portal.org/FinkJ194741.57+223702.3>

g band r band



✓ Difference magnitude

DC magnitude

DC flux



# FUOR VARIABLES



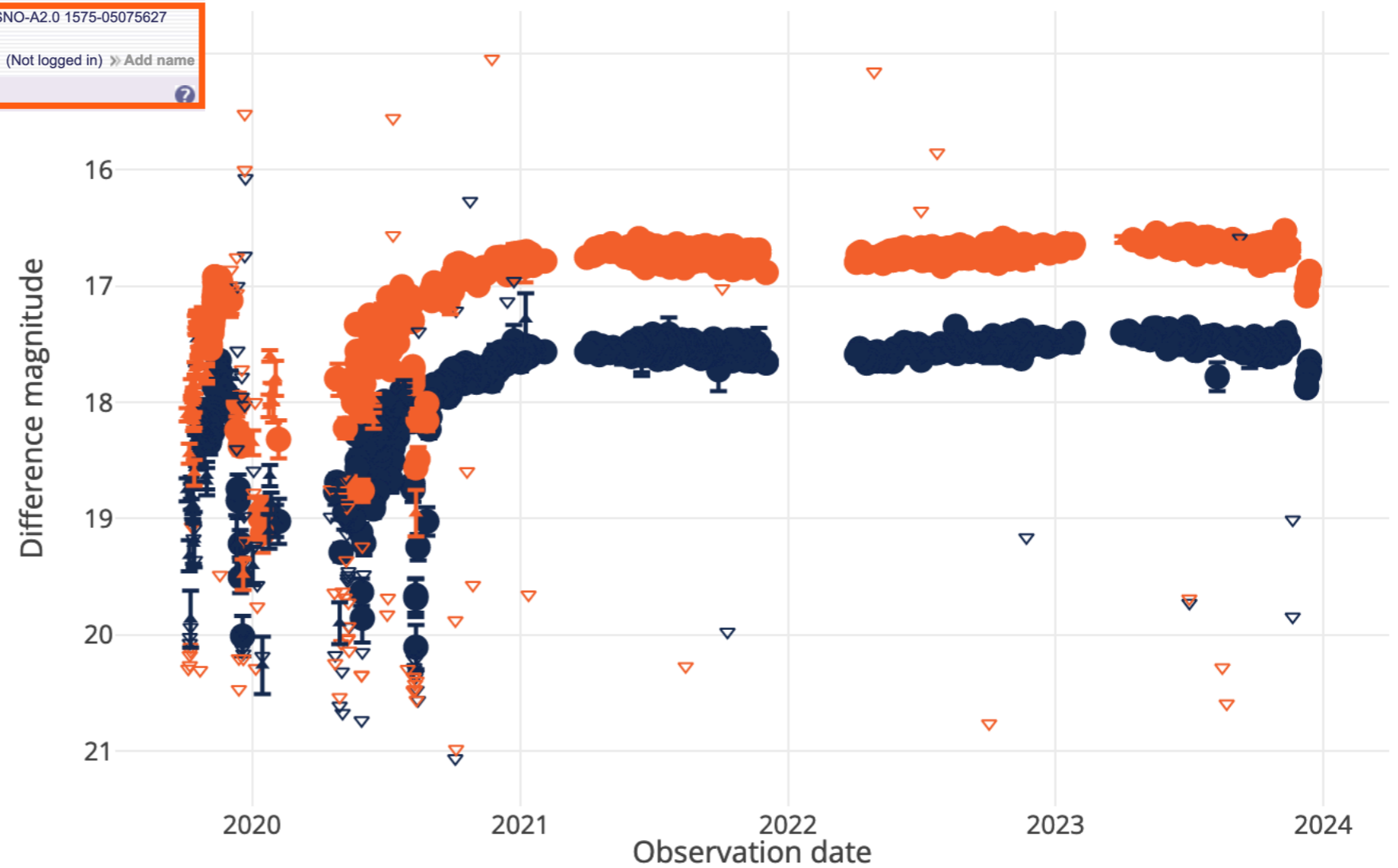
## Latest Details

Log in to retrieve additional aliases from SIMBAD.

Name	<input checked="" type="checkbox"/> ZTF18abgpgxt
AAVSO UID	000-BPS-475 (No observations)
Constellation	Cepheus <a href="#">» Sequence</a>
J2000.0	22 23 24.30 +74 42 22.1 (335.85125 +74.70614) <a href="#">» Search nearby</a>
B1950.0	22 22 30.11 +74 27 08.4
Galactic coord.	113.488 +14.618
Other names (Internal only)	Fink J222324.32+744222.0 PSO J030720.634+131303.698 USNO-A2.0 1575-05075627 USNO-B1.0 1647-0115945 (Not logged in) <a href="#">» Add name</a>
Variability type	FUOR: <a href="#">?</a>

<https://fink-portal.org/FinkJ222324.32+744222.0>

g band  r band

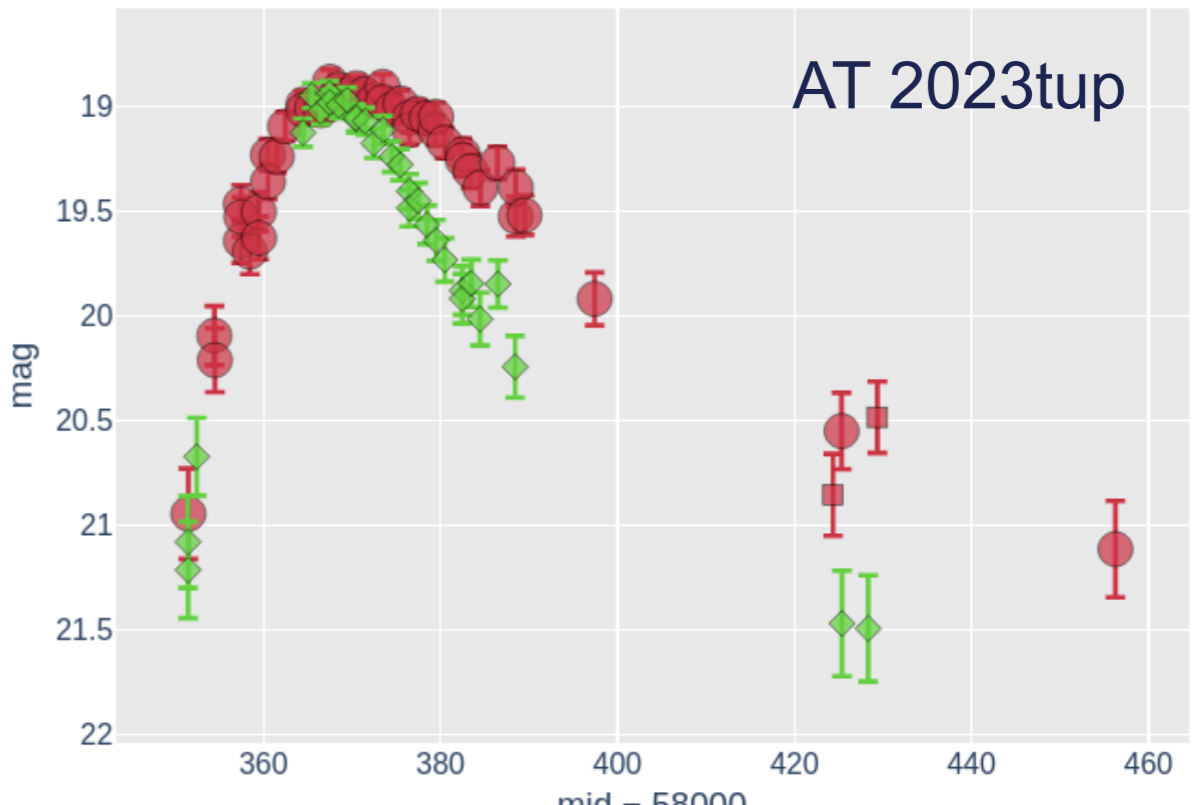
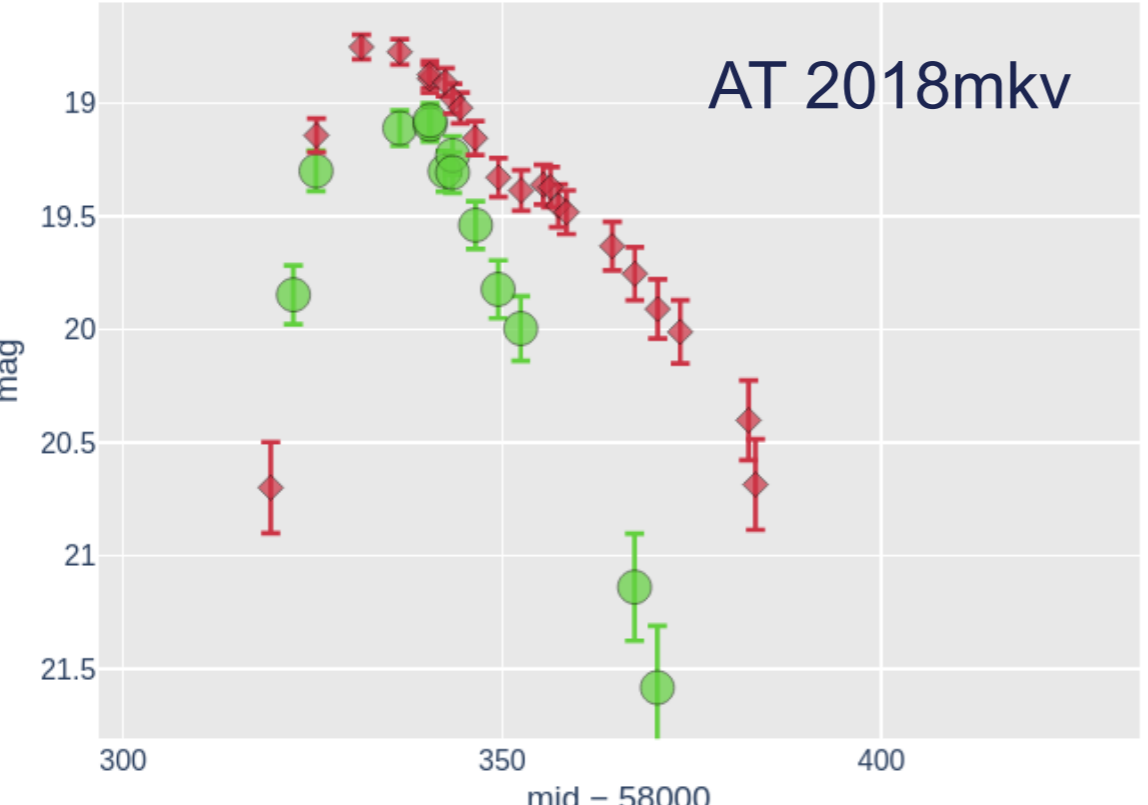
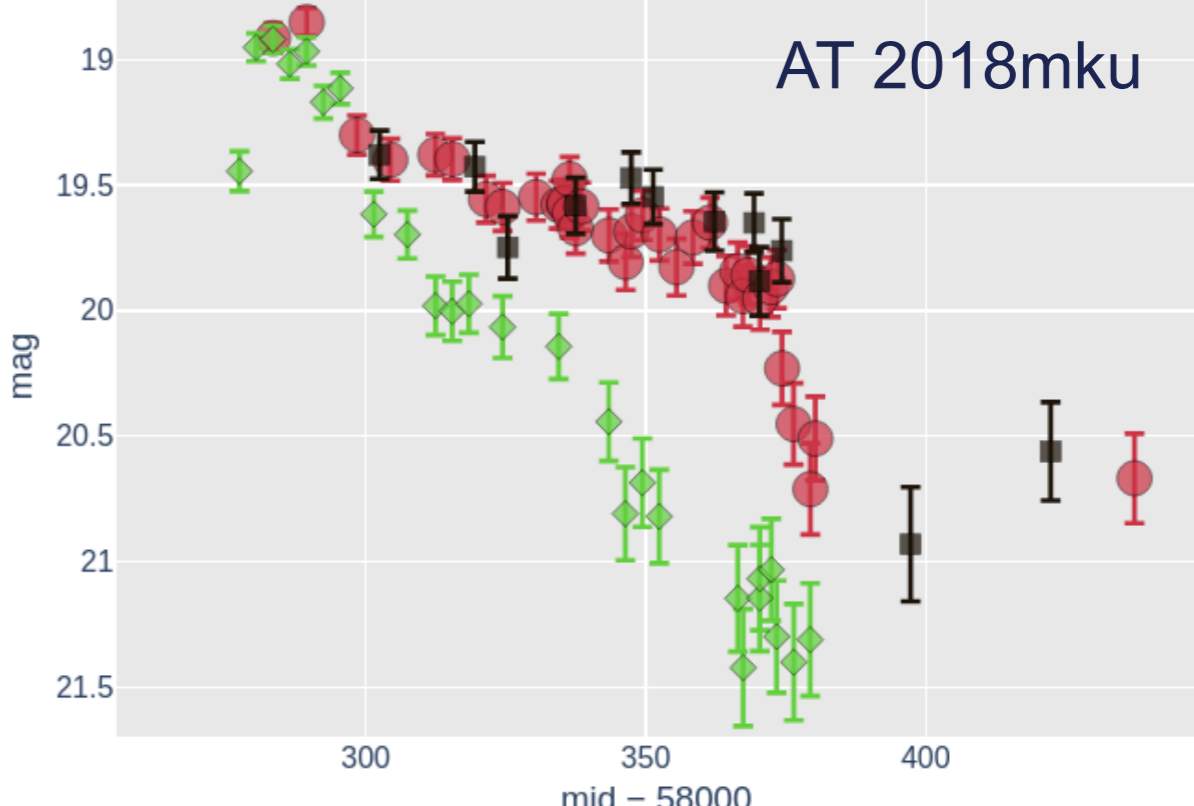
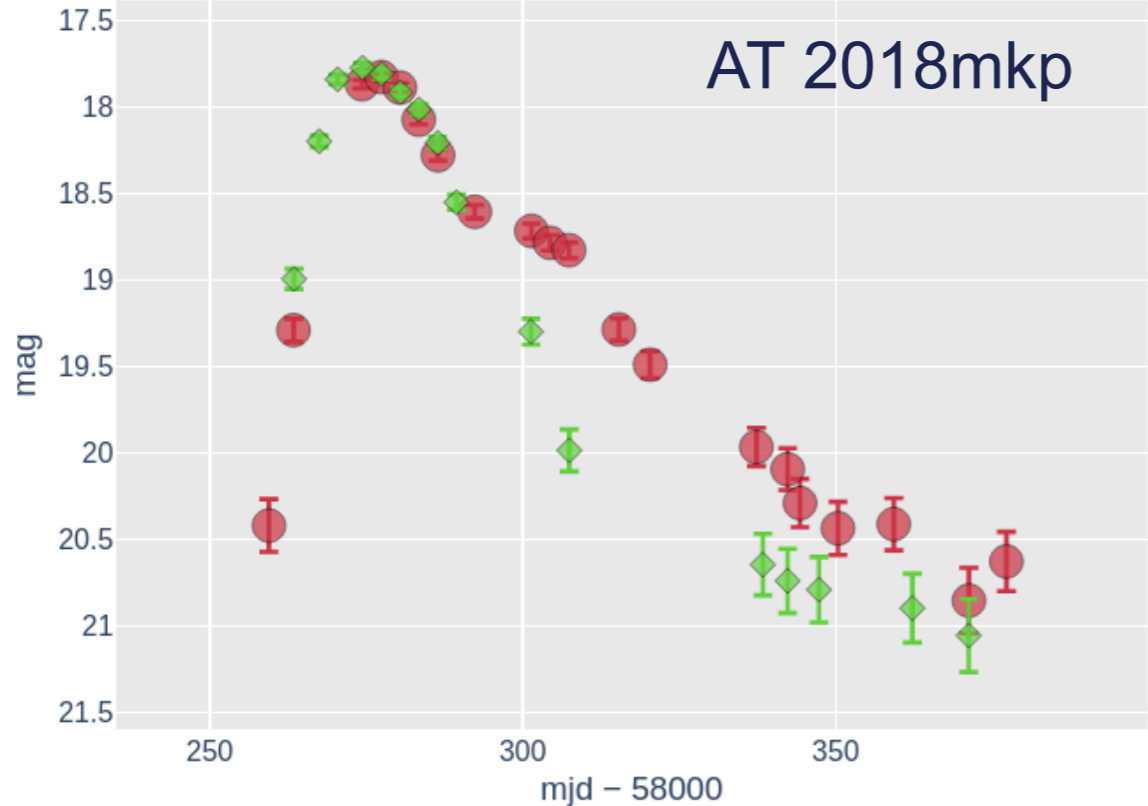


Difference magnitude

DC magnitude

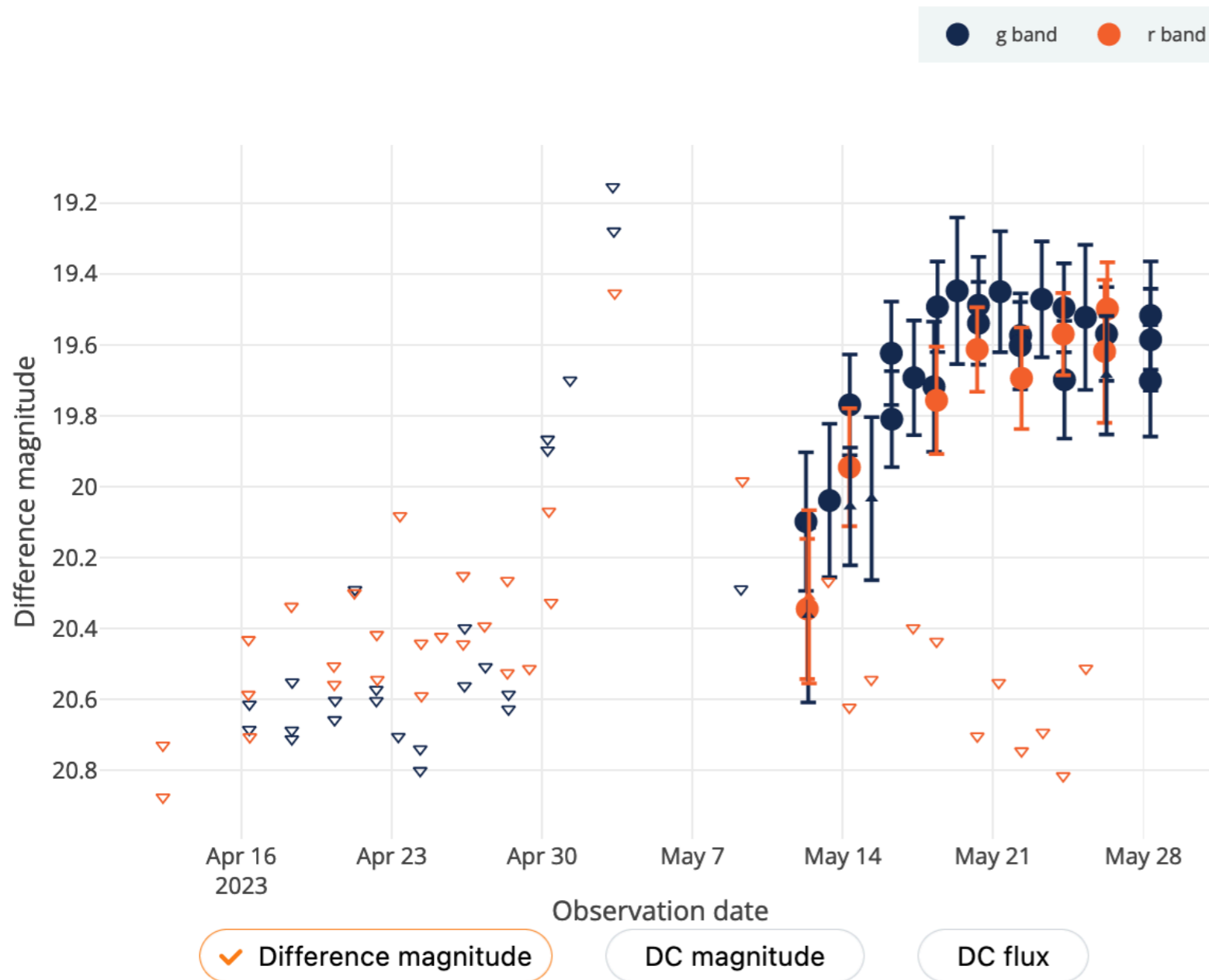
DC flux

# SUPERNOVAE



# HOSTLESS TRANSIENTS

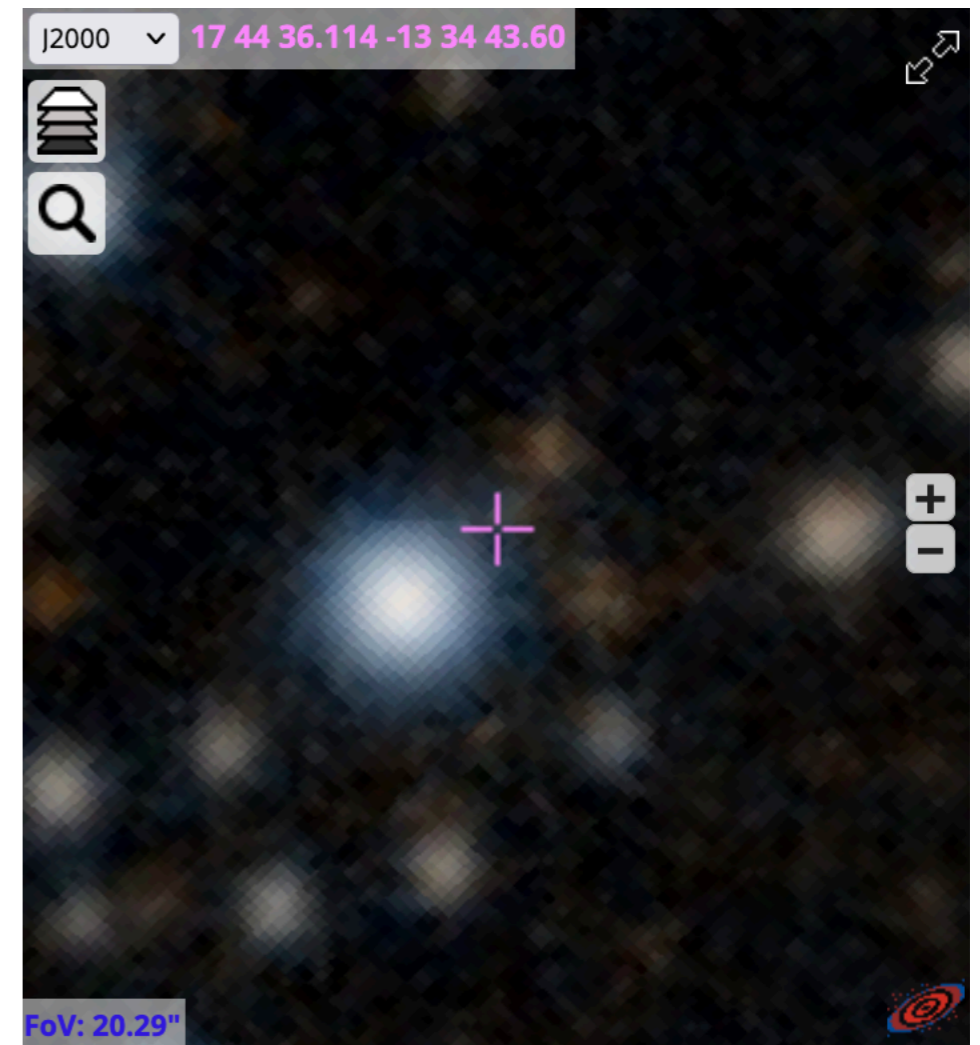
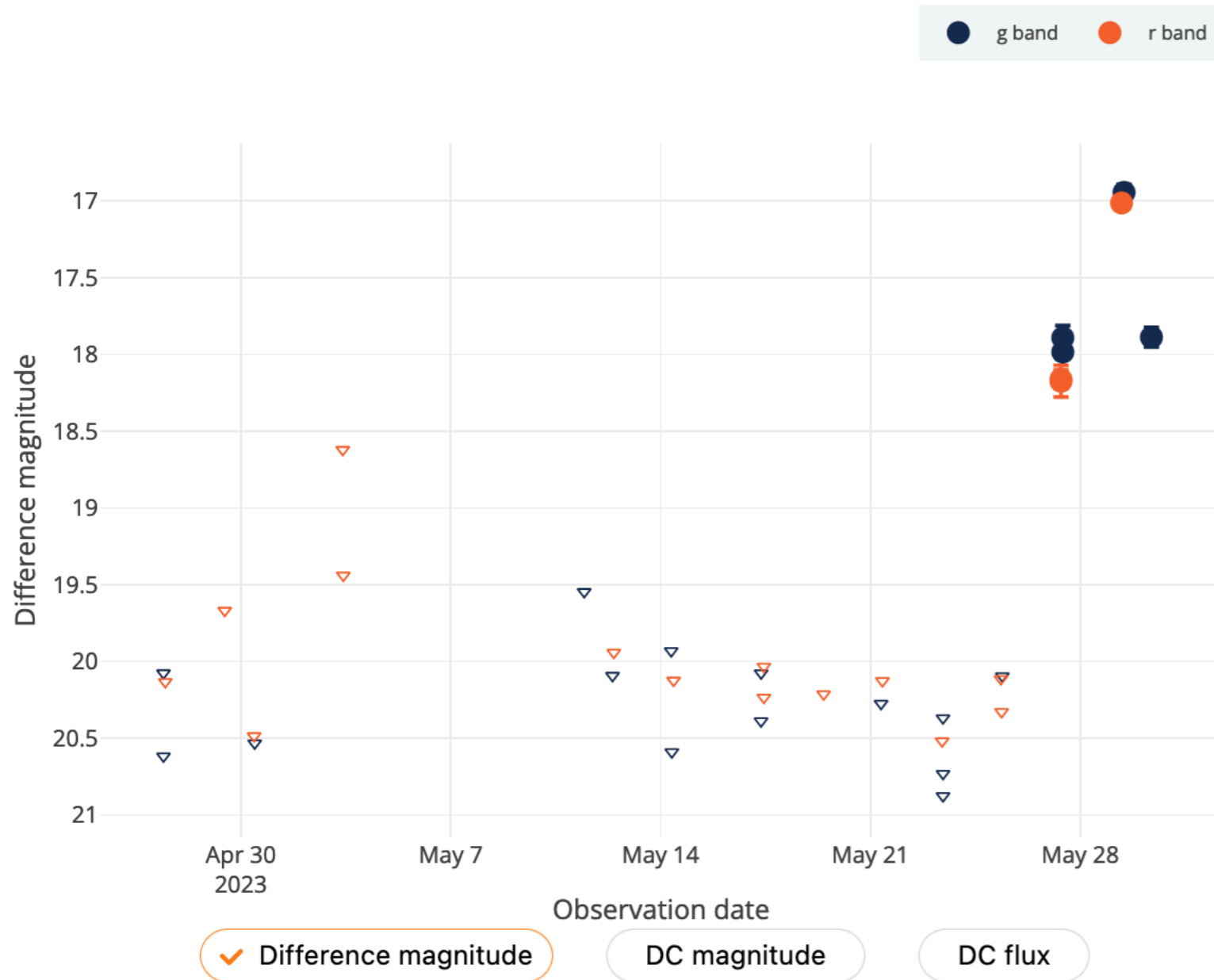
<https://fink-portal.org/ZTF23aajaimx>



REPORTED IN TNS AS AT 2023IRO

# FAST TRANSIENTS

<https://fink-portal.org/ZTF23aamcbjv>







# ACTIVE ANOMALY DISCOVERY IN FINK

NEW!

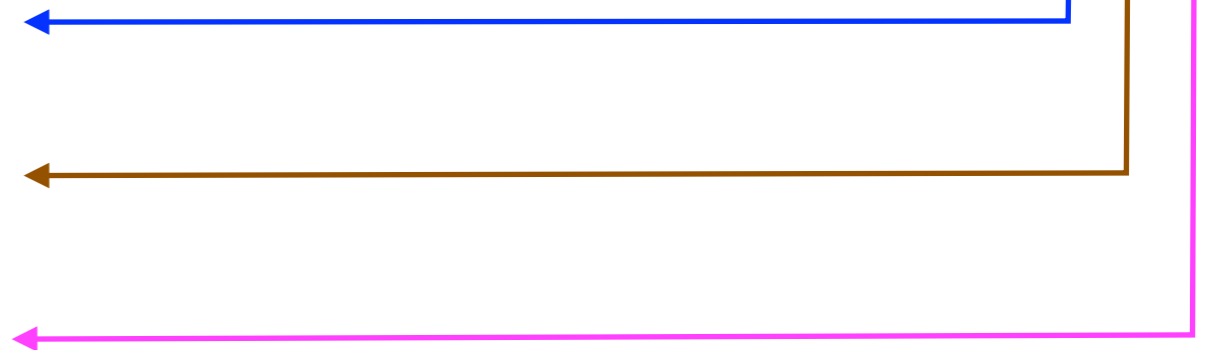
Active anomaly discovery in the alert stream  
for **personalized** anomaly detection models



ANOMALY MODEL-1

ANOMALY MODEL-2

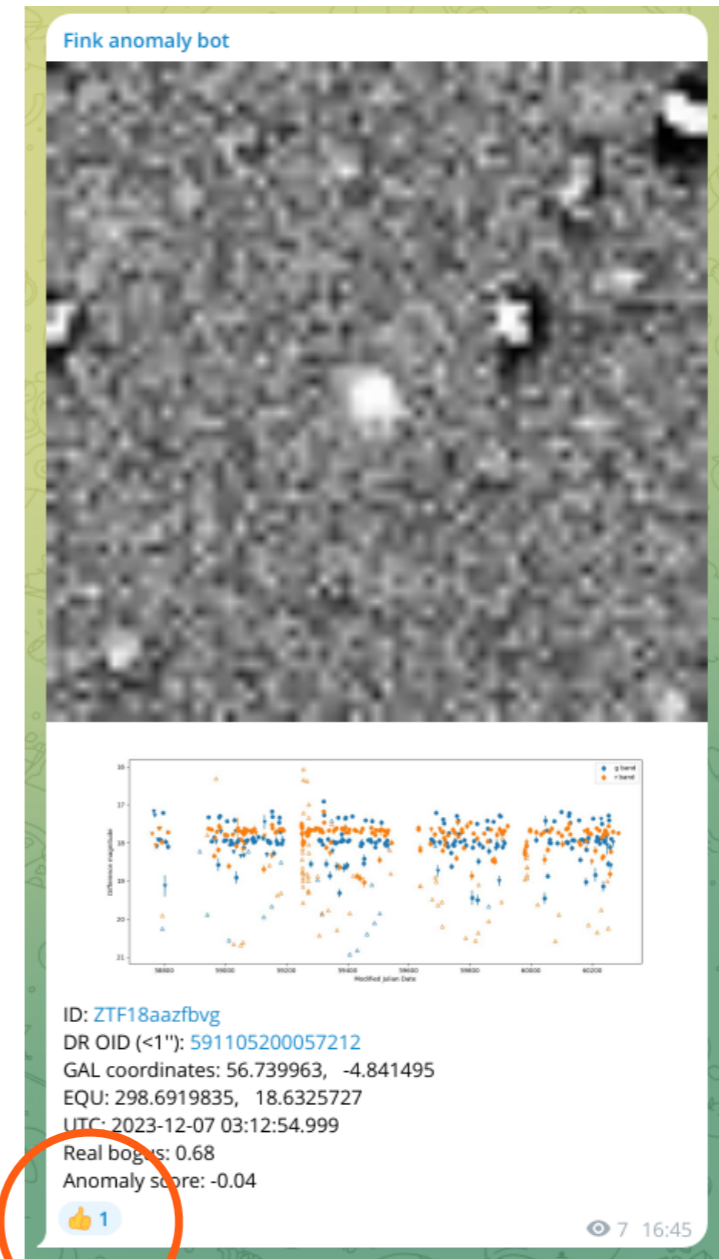
ANOMALY MODEL-3



# ACTIVE ANOMALY DISCOVERY IN FINK

- ▶ User input through reactions
- ▶ Database maintenance
- ▶ User authentication
- ▶ Version control

**Initial tests are promising!**



# SUMMARY

---

- ▶ Fink anomaly detection module is working and producing results
- ▶ Giving meaning to anomalies requires context
- ▶ A lot of infrastructure is necessary to allow coherent incorporation of expert's opinion
- ▶ Fink has been actively engaging community follow-up for exciting anomalies:
  - ▶ AT2023awt: 9.2m SALT (South Africa), 0.6m and 2.5m KGO (Russia), 0.25m FRAM-ORM (Spain)
  - ▶ SN 2023mtp: 2.5m KGO (Russia)
- ▶ In the era of Rubin, serendipitous discoveries will not happen



**Stay tuned and join the channels!**



# TEEGARDEN'S STAR

## ZTF20abjgexp

- UNKNOWN
- ZTF: 0.2"
- PS1: 5.0"
- GAIA: 16.8"

Discovery date: 2020-07-18 10:24:44

Last detection: 2024-01-05 05:17:05

Duration: 1265.79 / 1535.82 days

Detections: 344 good, 43 bad, 106 upper

RA/Dec: 02 53 05.36 +16 51 41.6

