

DEBATING THE POTENTIAL OF MACHINE LEARNING IN ASTRONOMICAL SURVEYS

#2

SNAD: ENABLING DISCOVERY IN THE ERA OF BIG DATA



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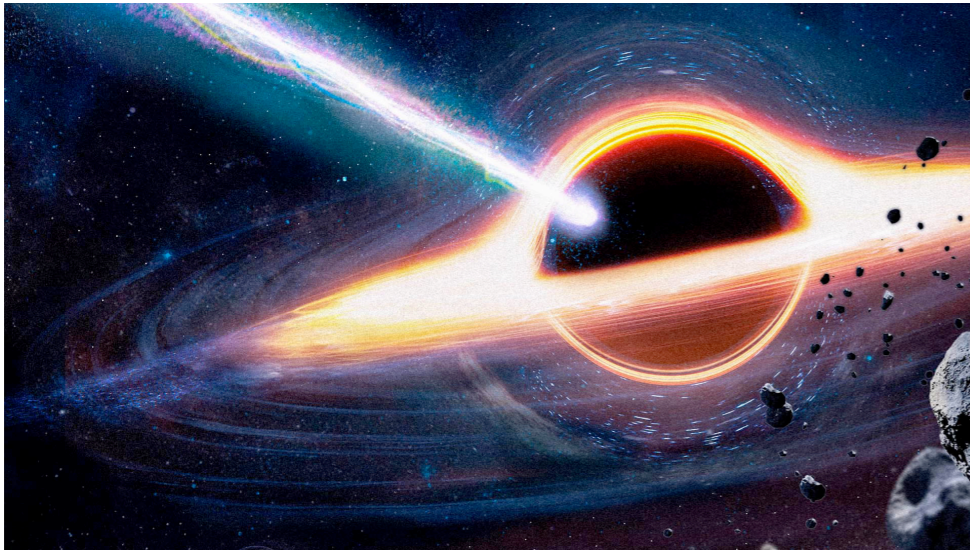
SNAD

<https://snad.space/>

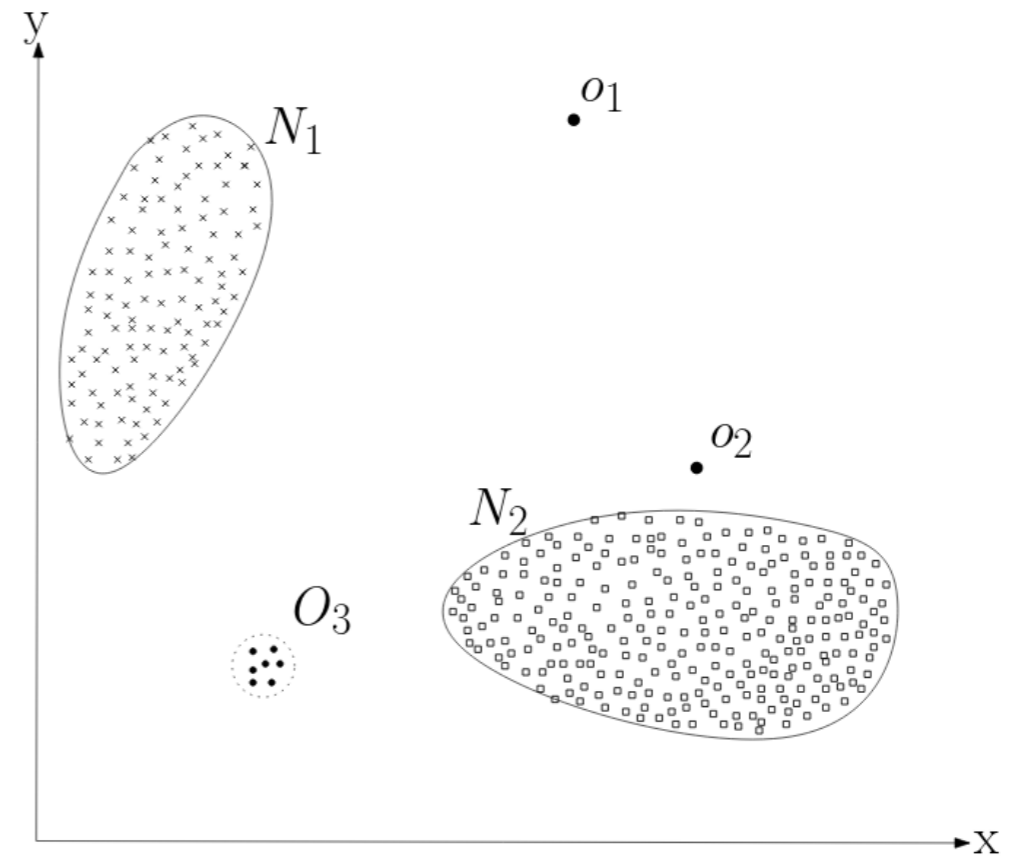
Project devoted to the anomaly detection problem
in astronomical databases and catalogues

WHAT IS ANOMALY?

HUMAN DEFINITION

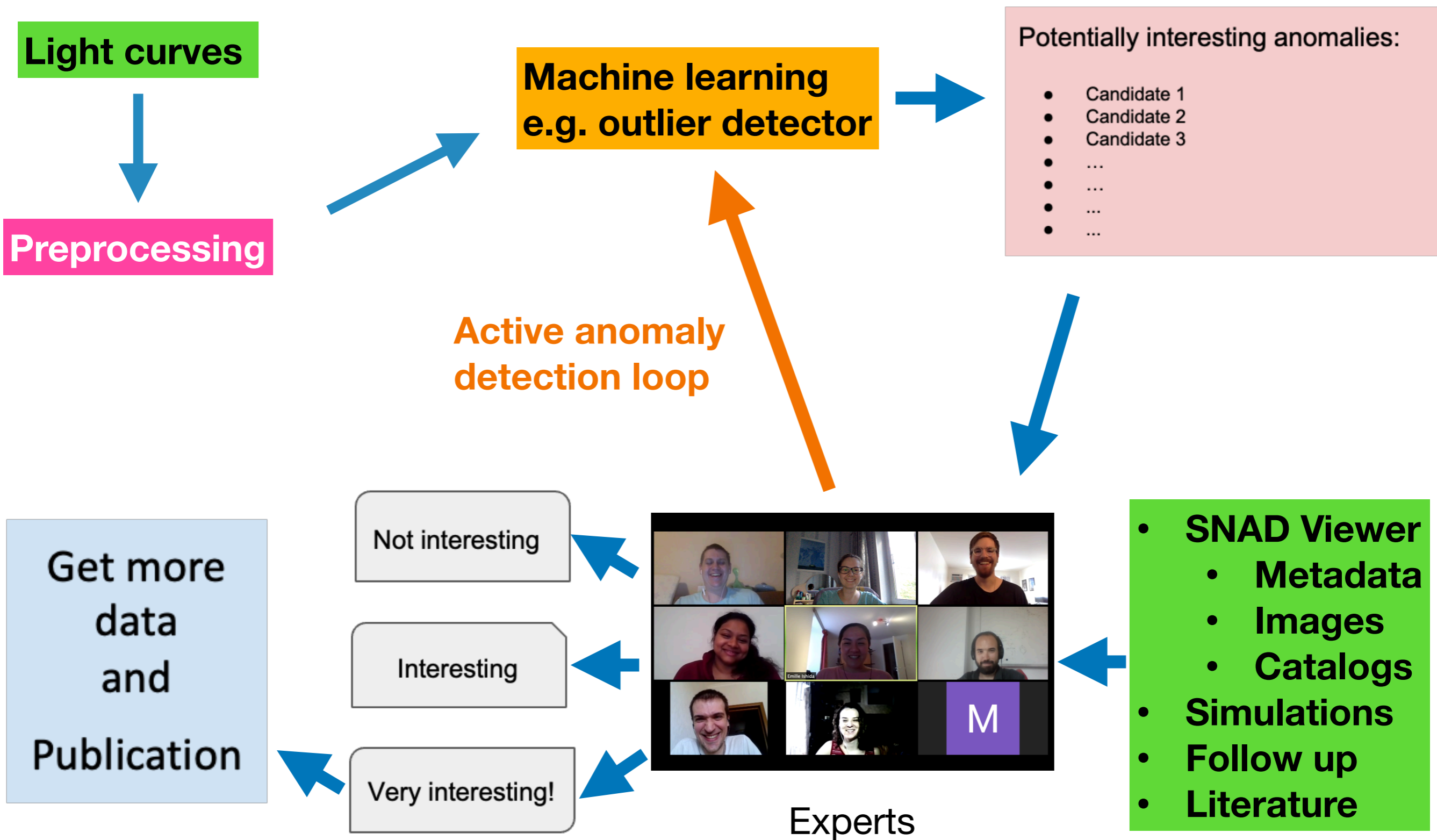


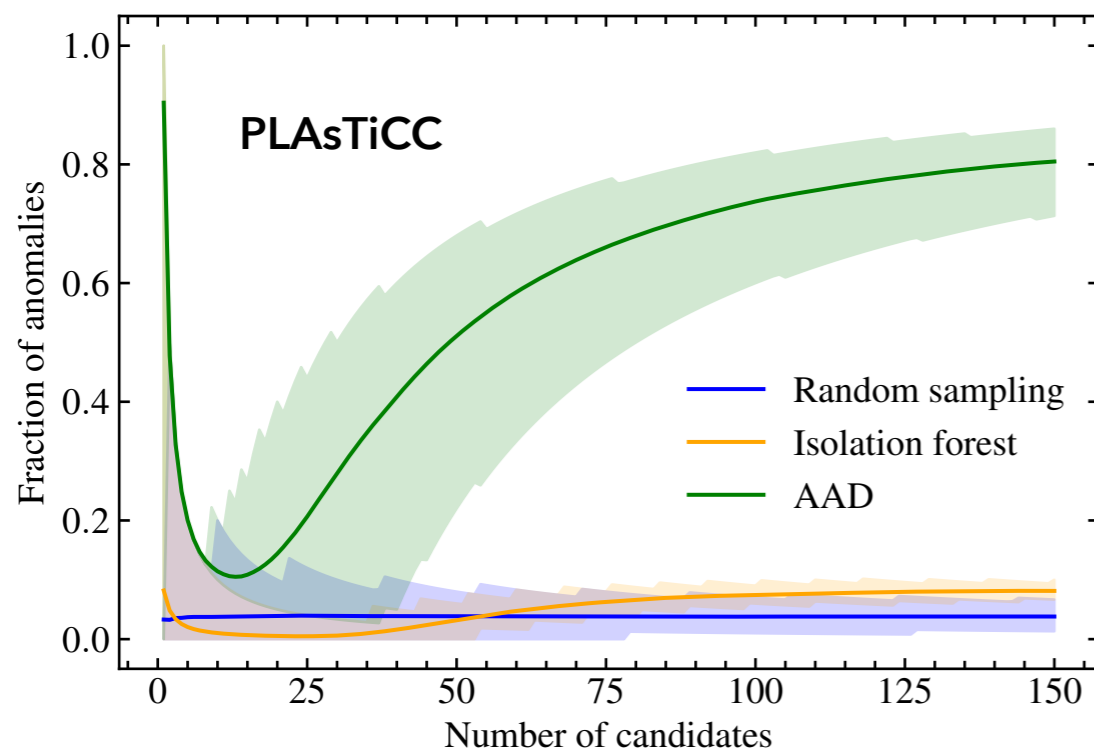
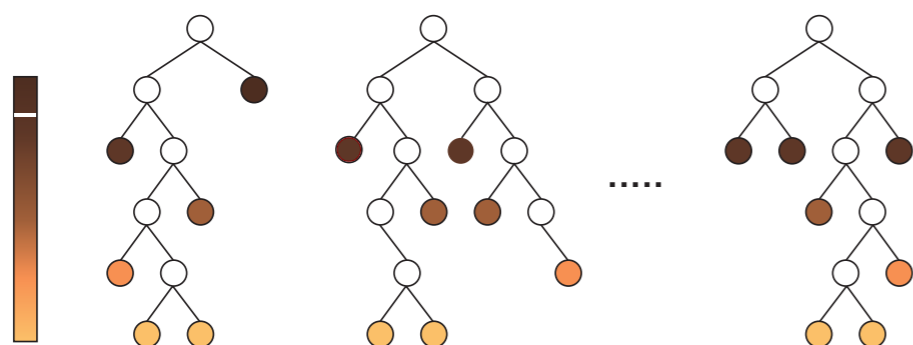
MACHINE DEFINITION



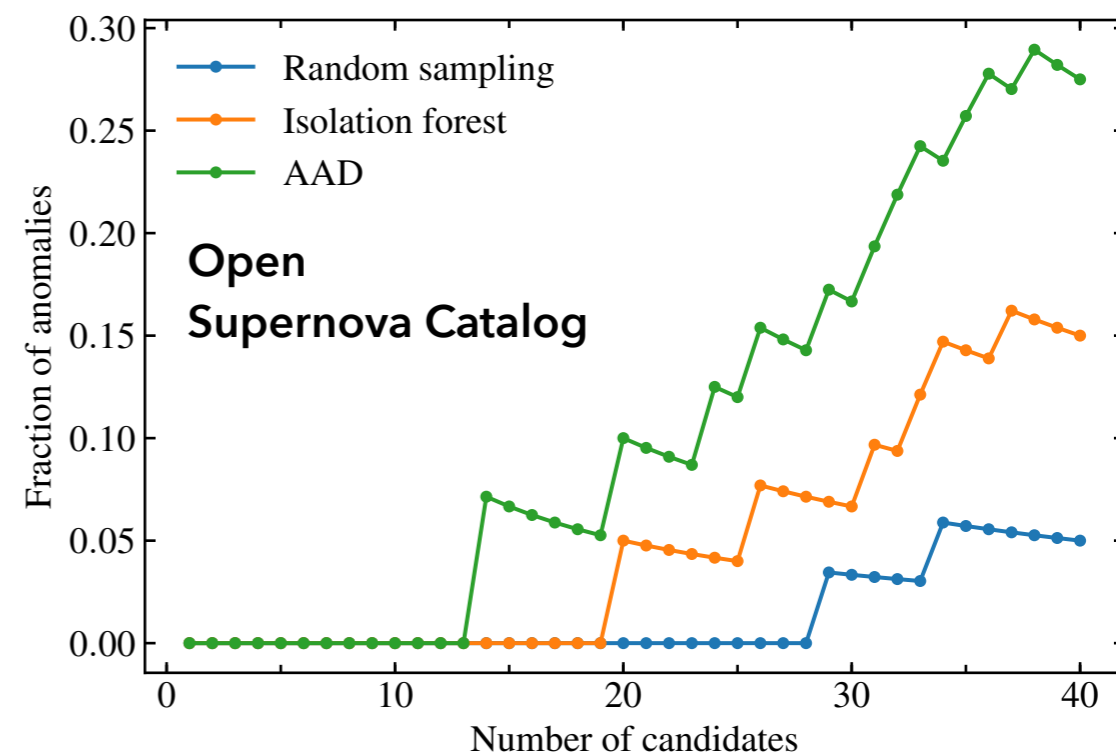
PIPELINE

ML produces recommendations only





AAD identifies 83% anomalies, IF only 8%



AAD identifies ~80% more anomalies than IF

Can be used as targeted transient search

~26.5 million light curves from the Zwicky Transient Facility DR3

- 104 SN-like transients (57 new + 47 known), including rare SN types

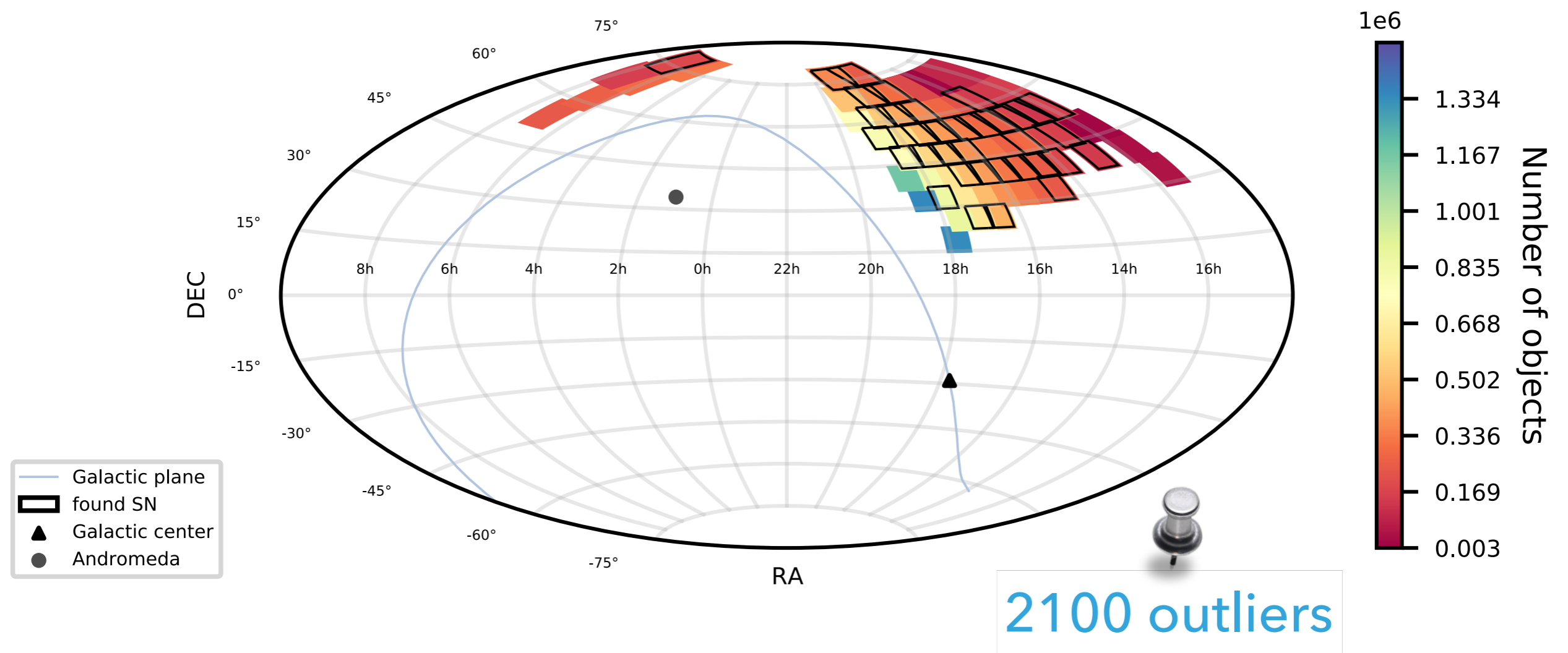
- SNAD objects posted to TNS



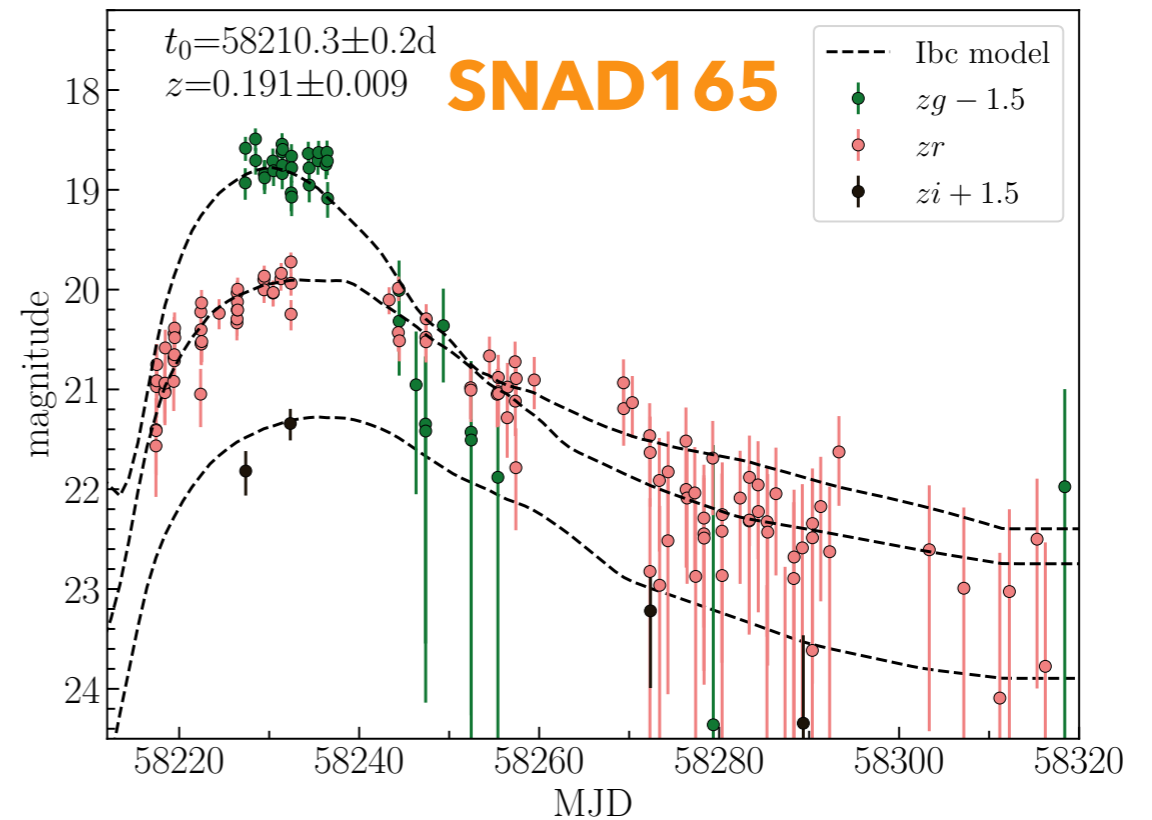
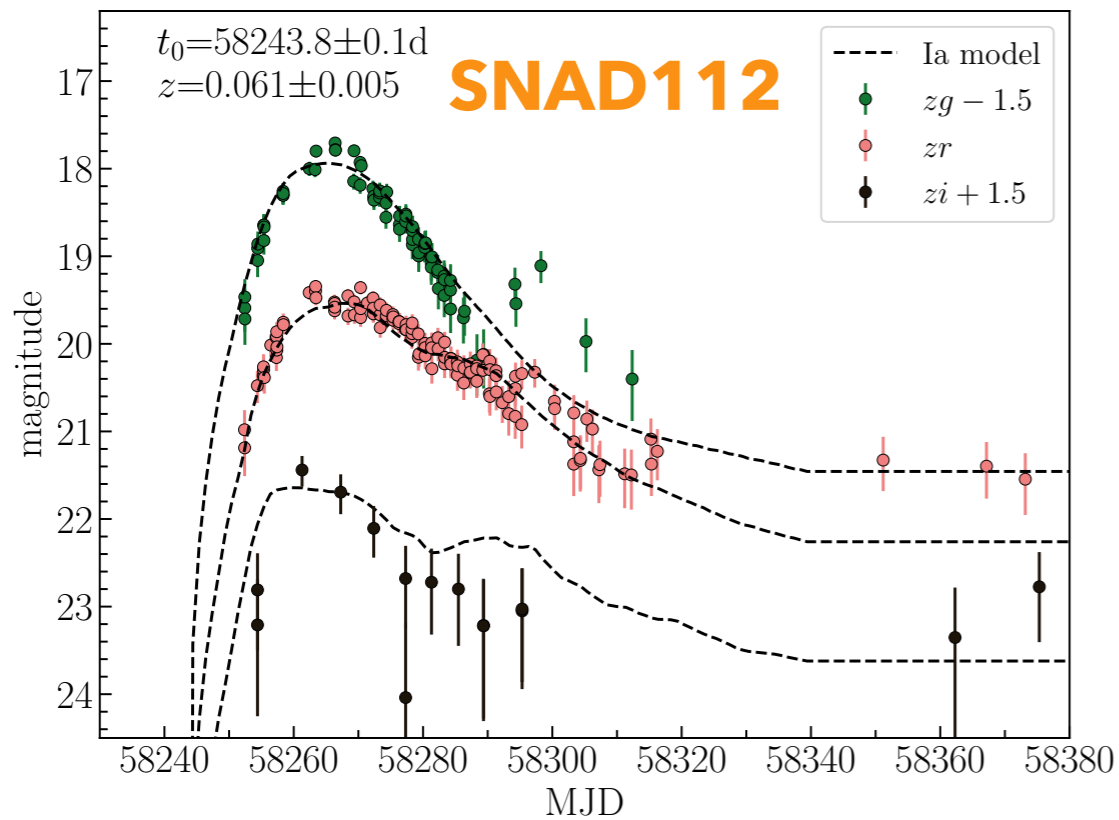
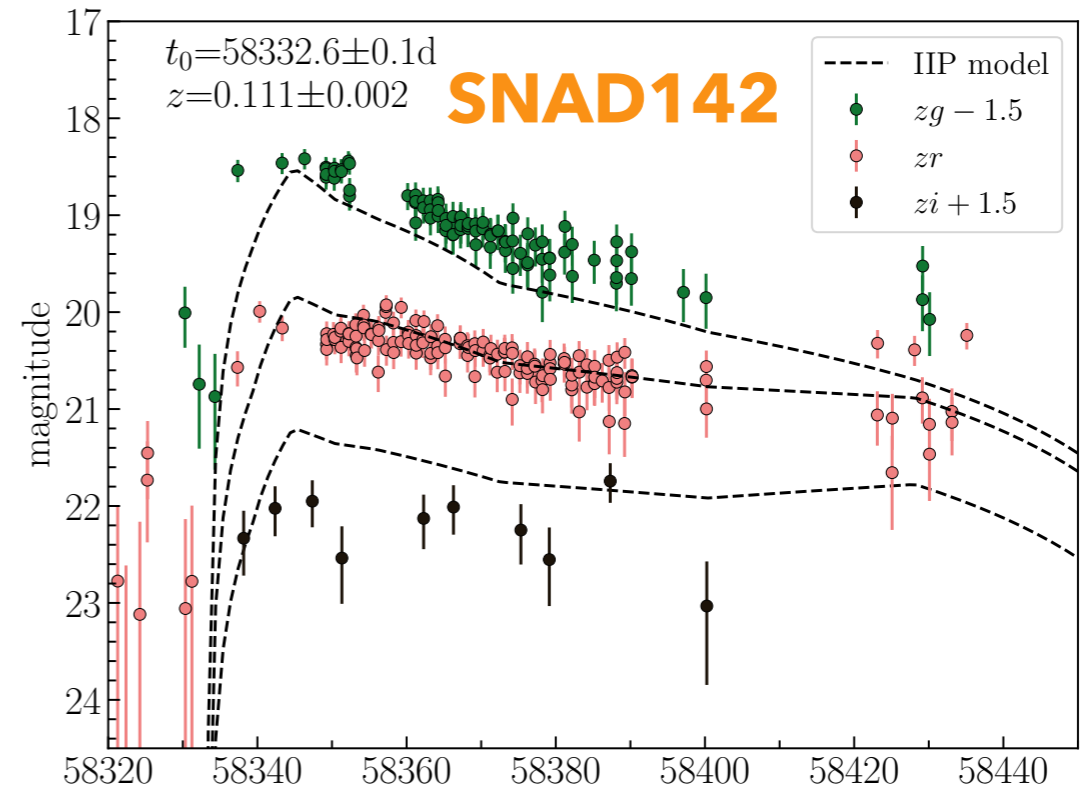
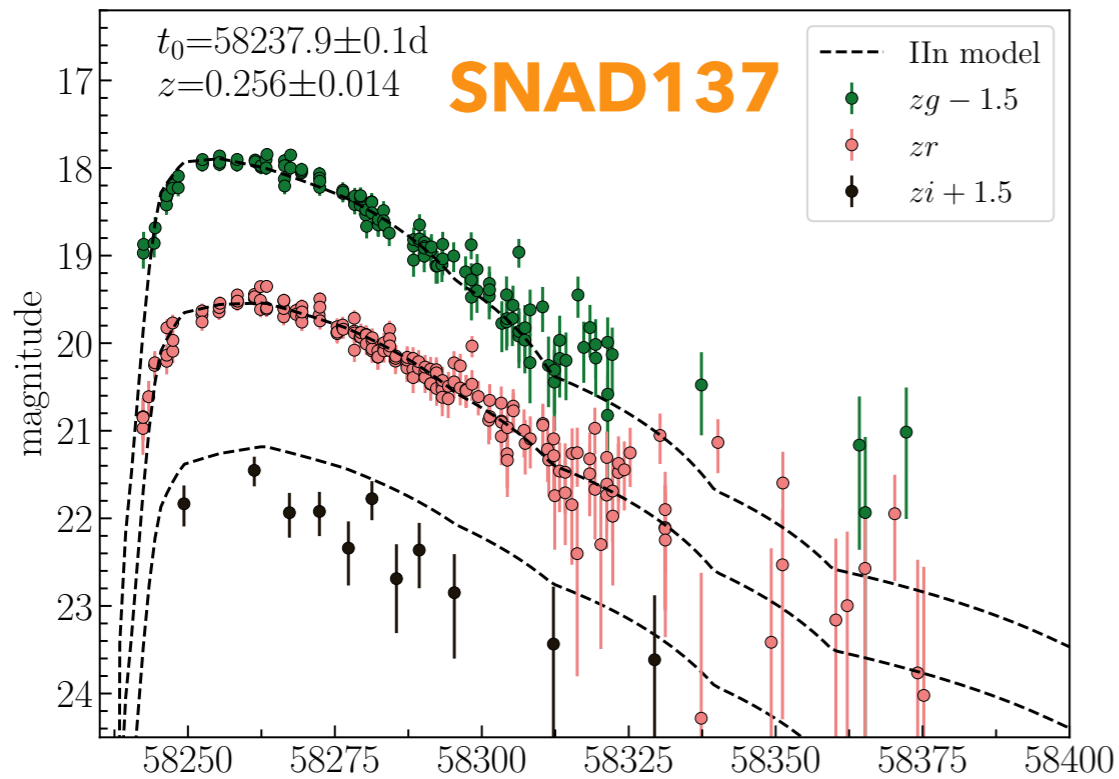
- well-sampled early light curves

update: 144

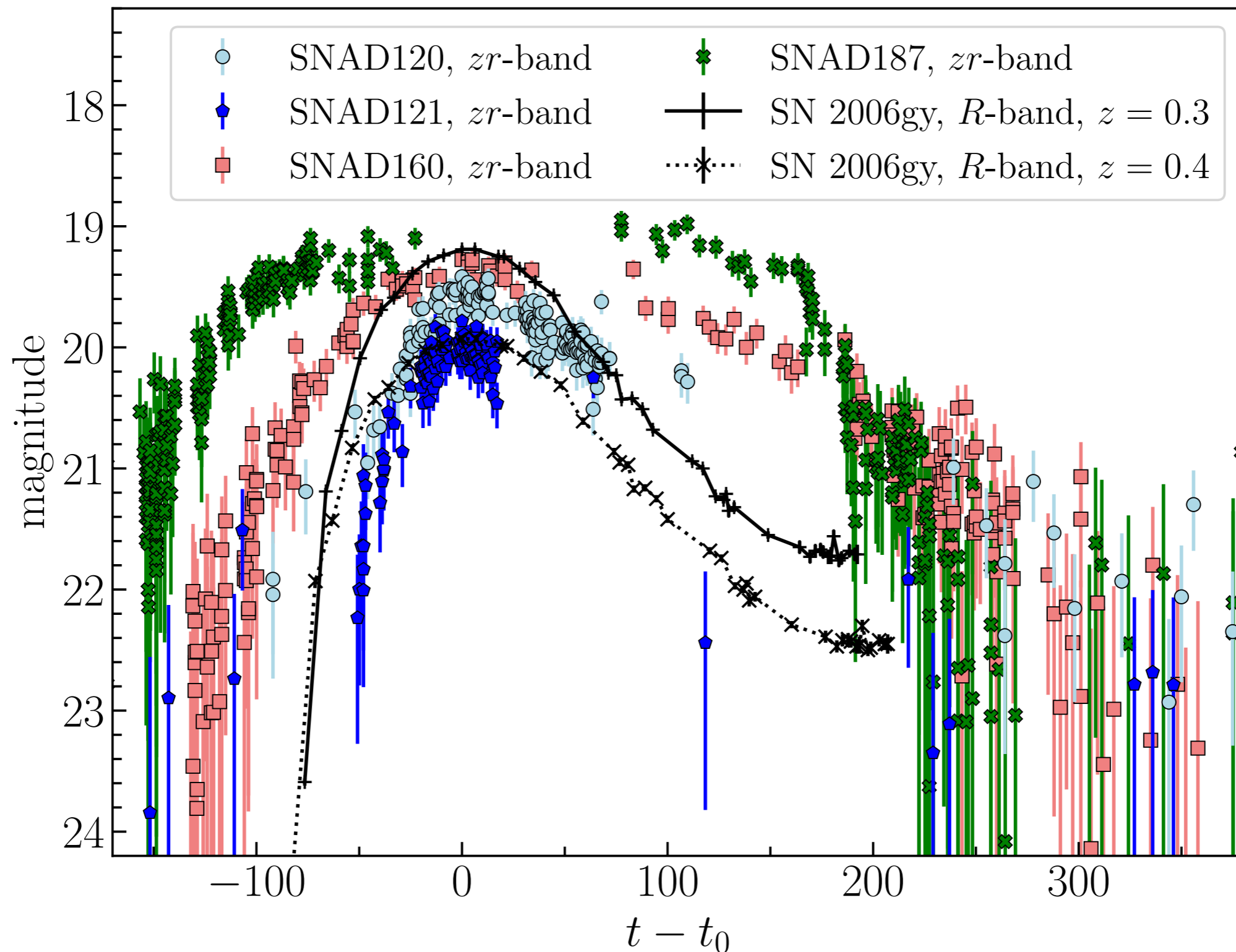
- 15 PSN are missing in alerts



P. Nugent's SN models (Ia, Ib/c, IIP, IIL, IIn)



SUPERLUMINOUS SUPERNOVAE

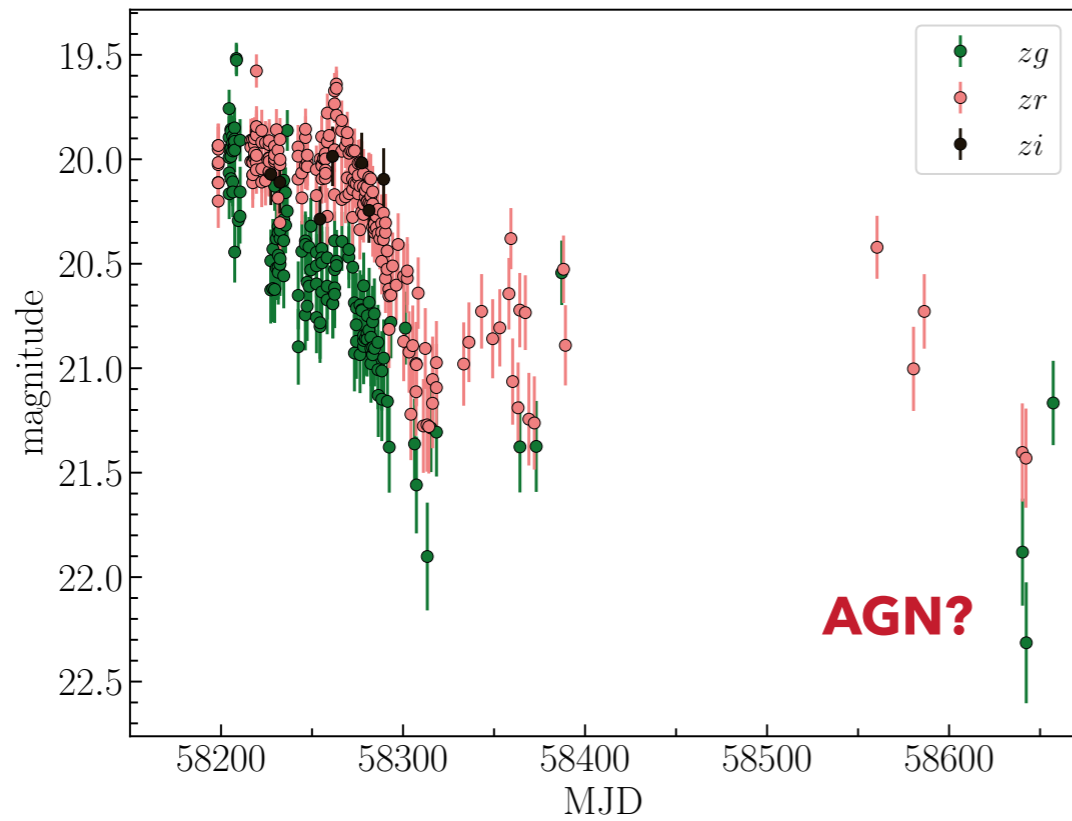


SNAD160 – PISN?

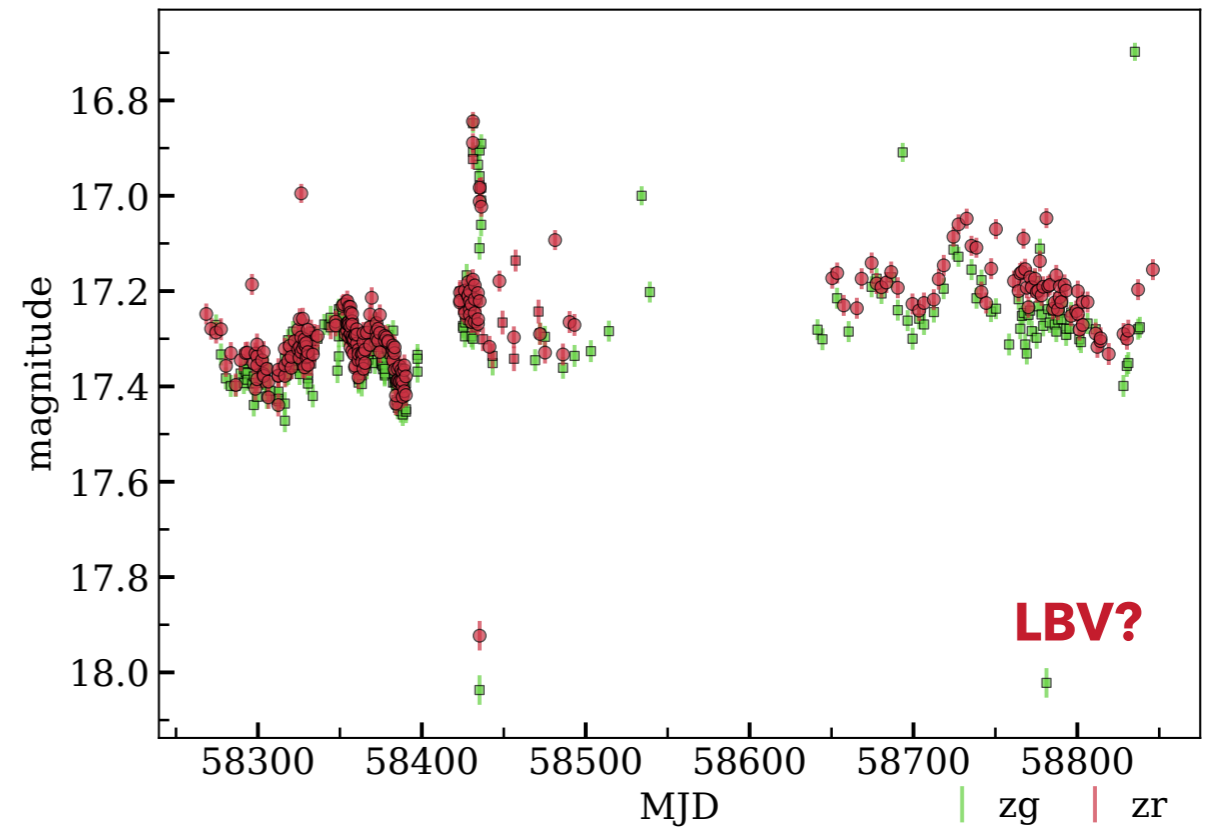
$z = 0.295$ (Credit: J. Cooke, A. Moller)

OTHER NON-CATALOGUED OBJECTS

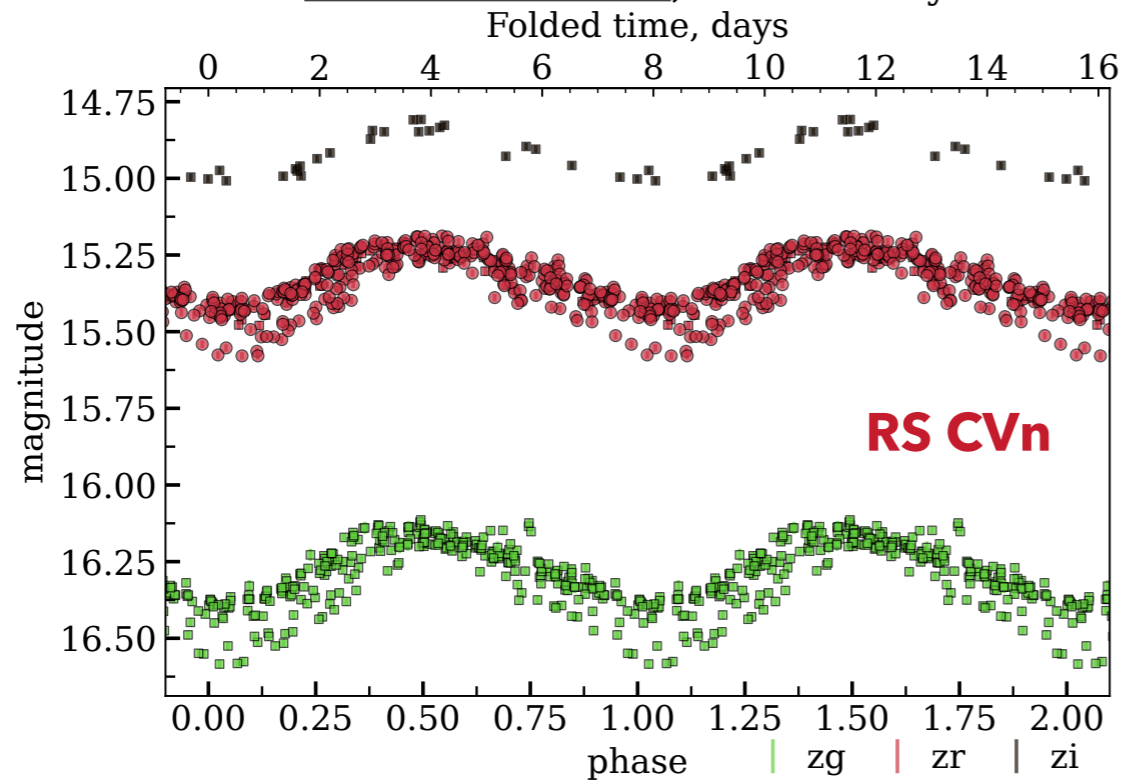
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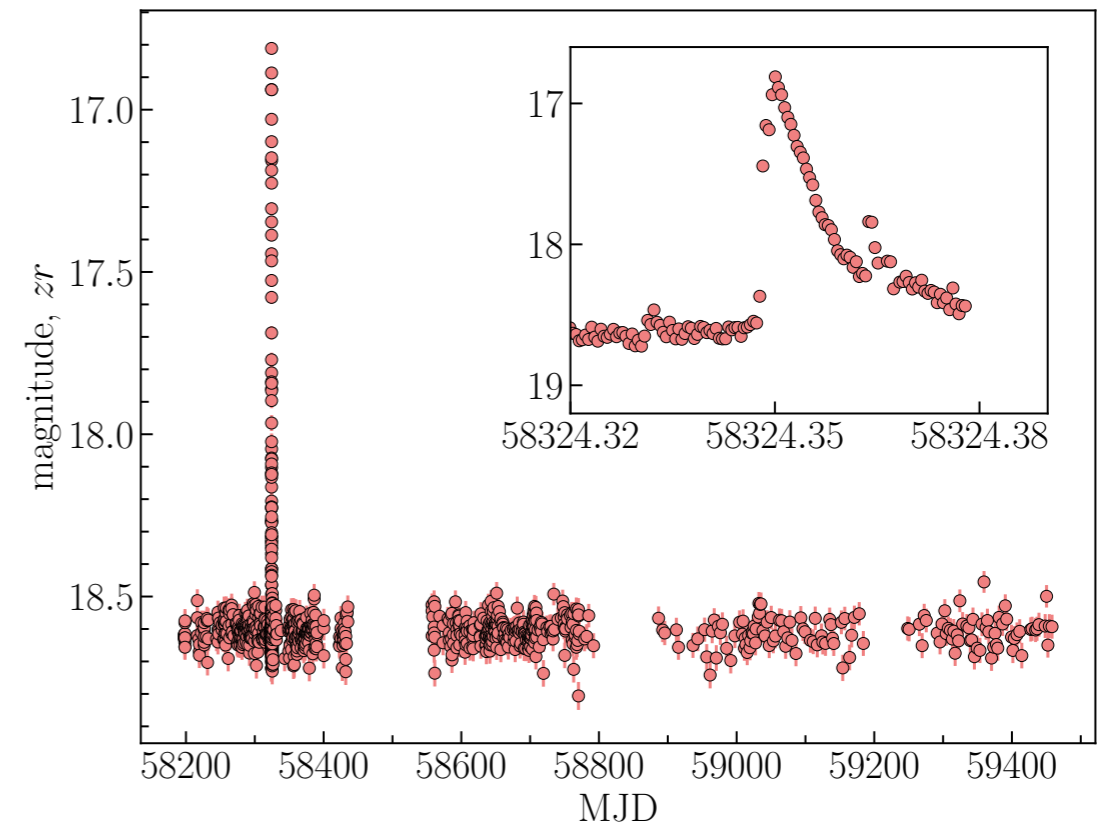
695211100131796

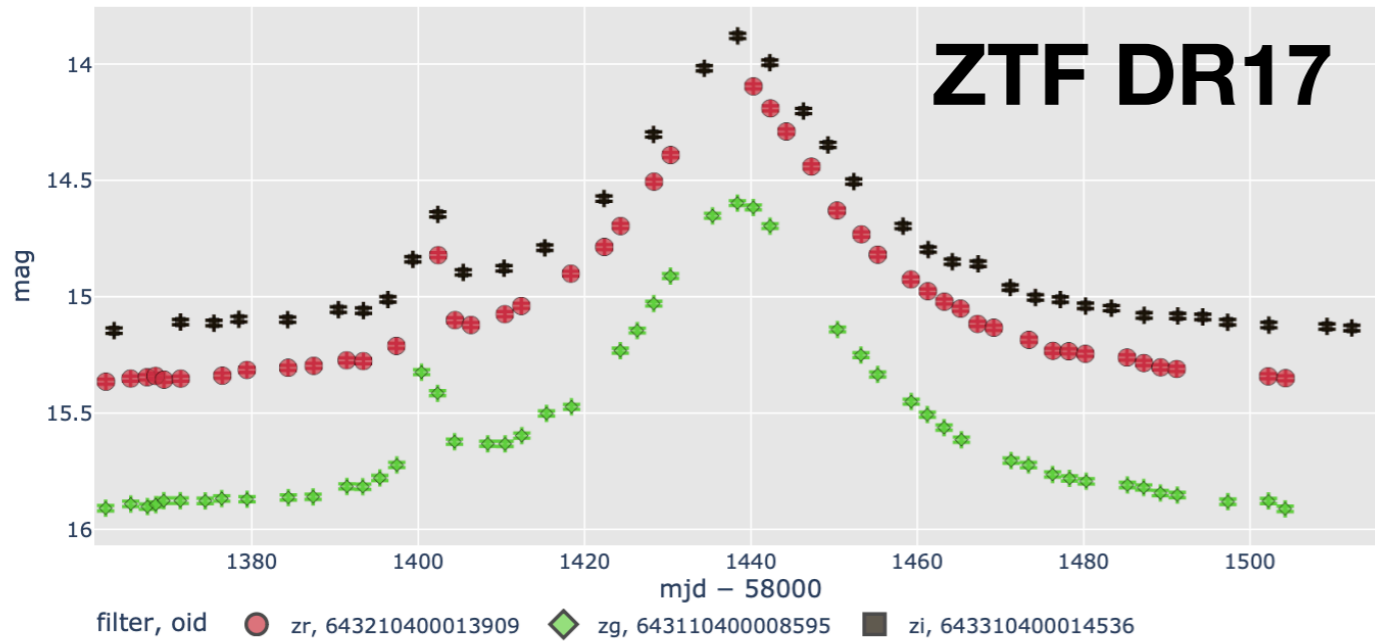


695211200019653, $P = 7.715$ days



726209400028833



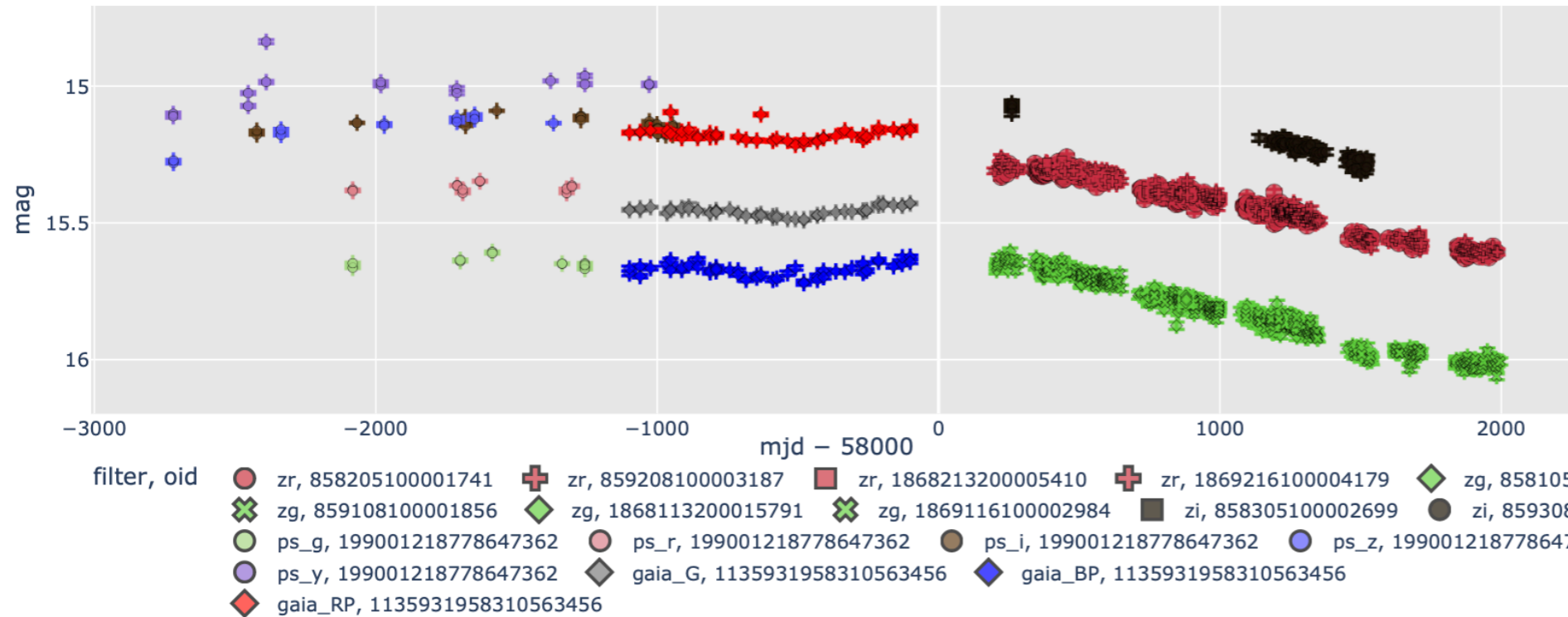


μ -lens candidate

PS1 DR2

Gaia DR3

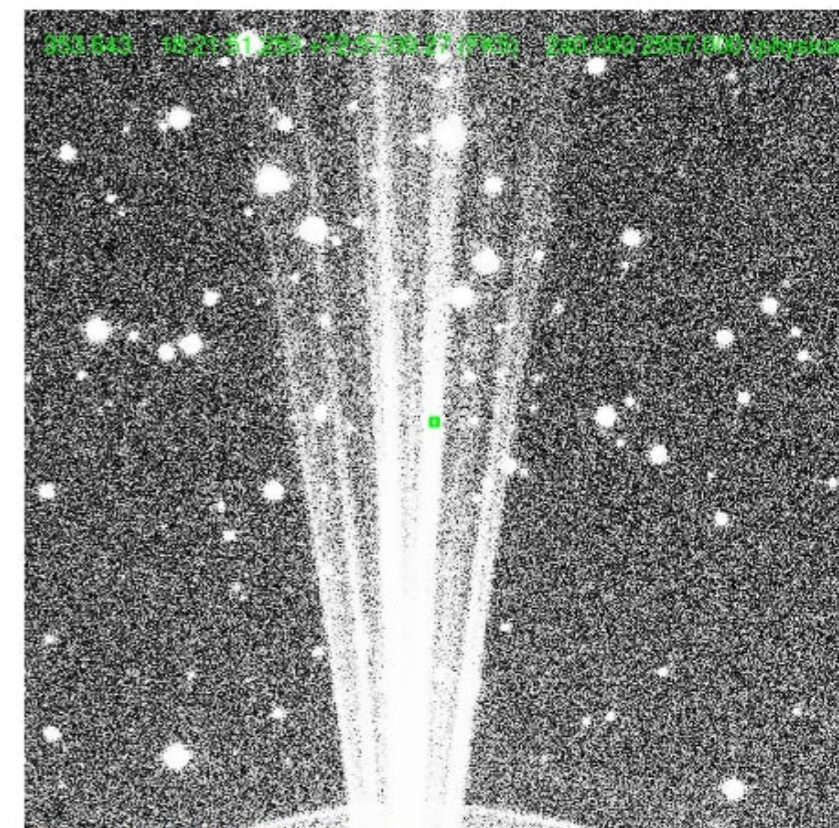
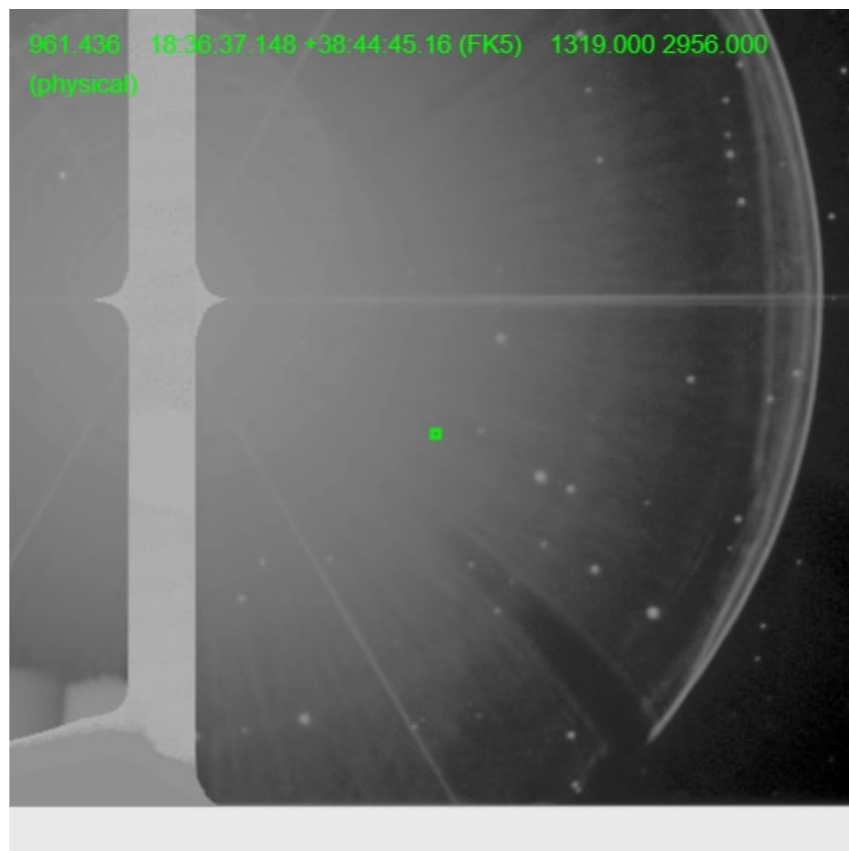
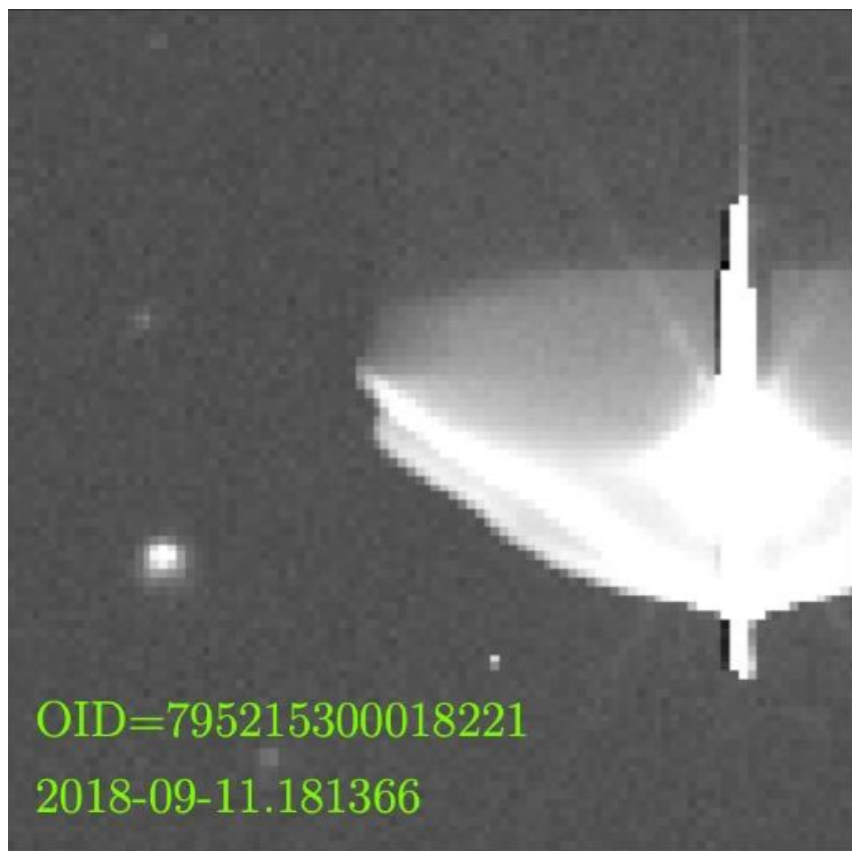
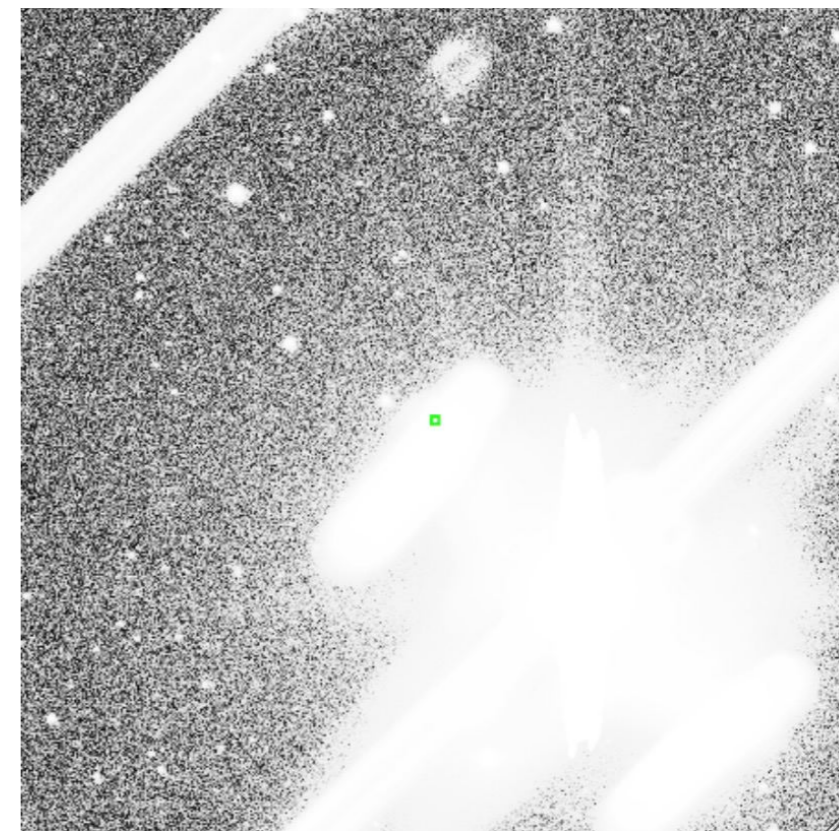
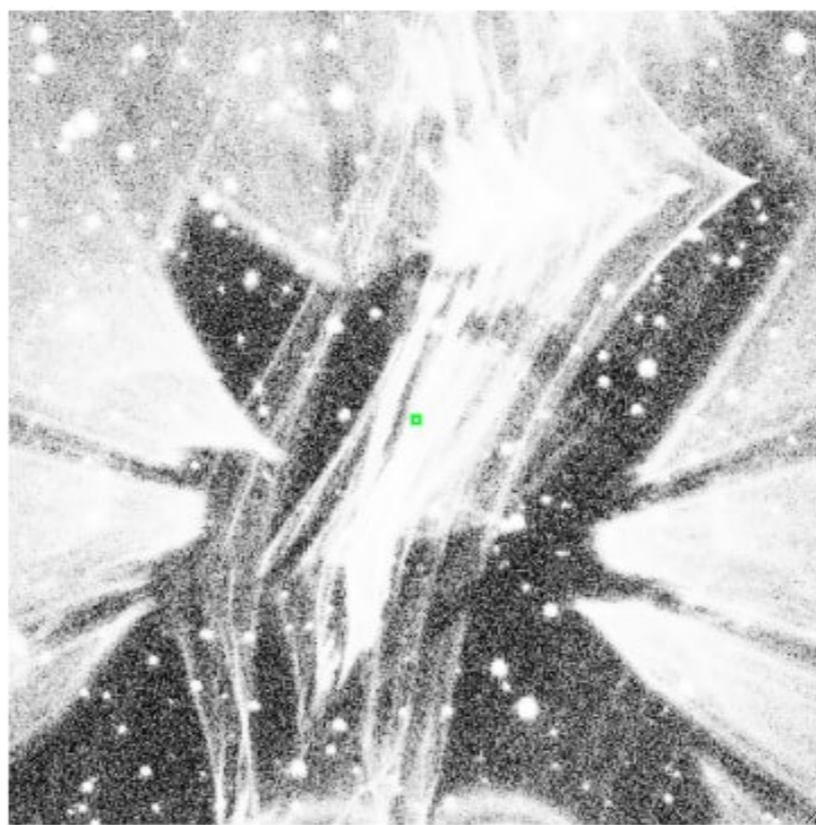
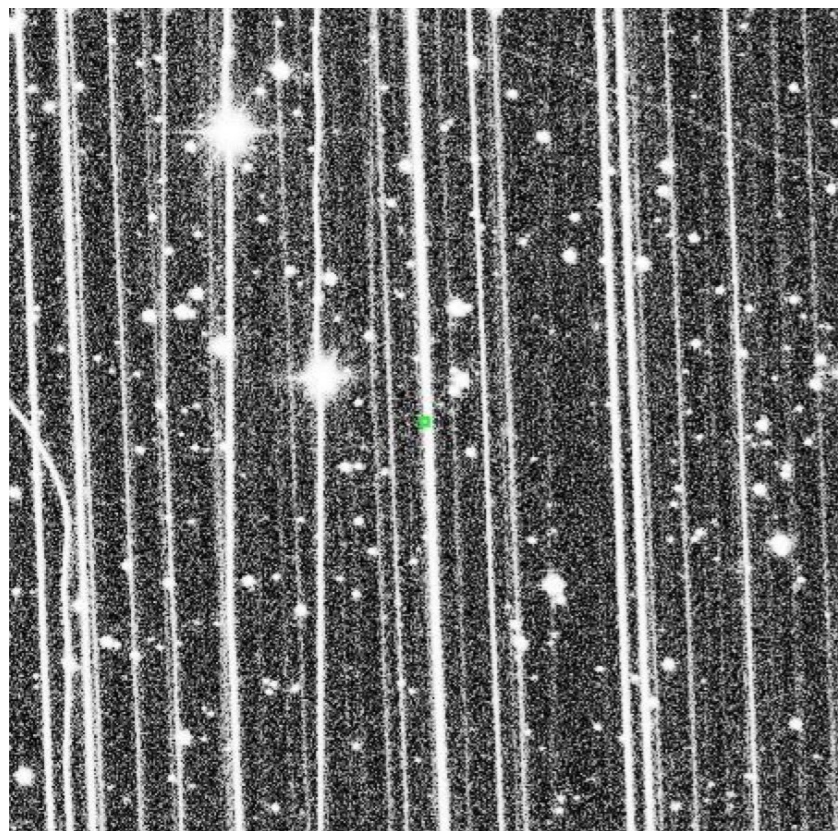
ZTF DR17



Optical
counterpart of
radio source
NVSS
J080730+755017

ARTEFACTS

<https://snad.space/art>



SNAD ZTF DR8 object viewer

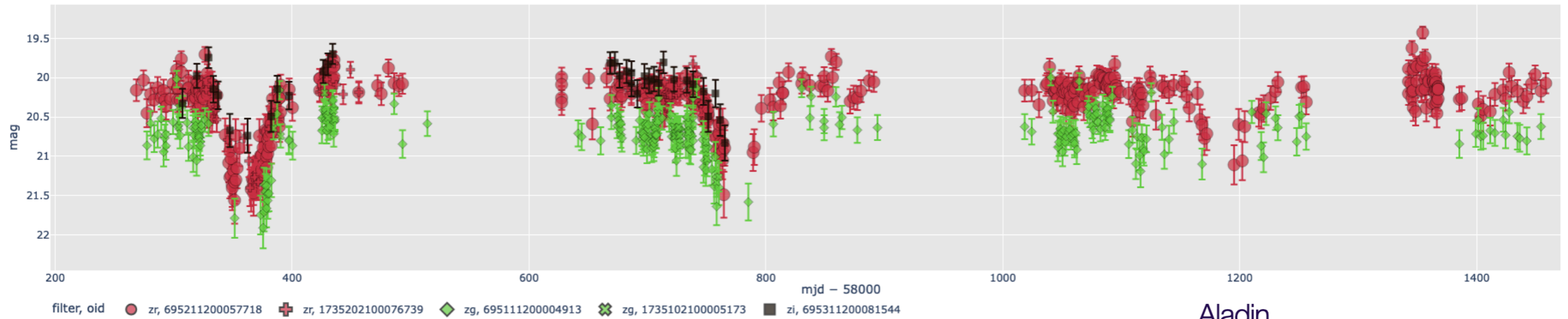
OID

Coordinates radius (arcsec)

695211200057718

"Short" light curve: $58194.0 \leq \text{MJD} \leq 58972.0$

Full light curve Folded light curve



Download [PNG](#), [PDF](#)

Summary

Name: ZTF18abndjoi (0.087" [Alerce](#)), 381257684160228608 (0.173" [Gaia EDR3 Distances](#)), [DBL2003] 12 (27.149" [Simbad](#))

Distance: 1711.24 pc (0.173" [Gaia EDR3 Distances](#))

Type: C* (27.149" [Simbad](#))

Period, days: 132.517 ([periodogram S/N=17.749](#))

Average mag (including neighbourhood): zg 20.71, zr 20.30, zi 20.13, (zg-zr) 0.41

Extinction: SFD $E(B-V) = 0.07$, Bayestar & Gaia EDR distance $A_g = 0.23$ $A_r = 0.16$ $A_i = 0.12$

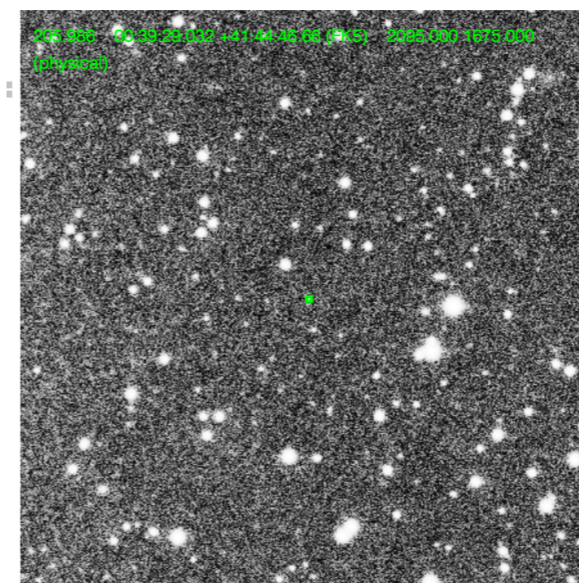
Search in brokers: [ALeRCE](#), [Antares](#), [Fink](#), [MARS](#)

Coordinates: Eq 9.82489 41.76983, Gal 120.507 -21.0448

Neighbours

Different passband, same field

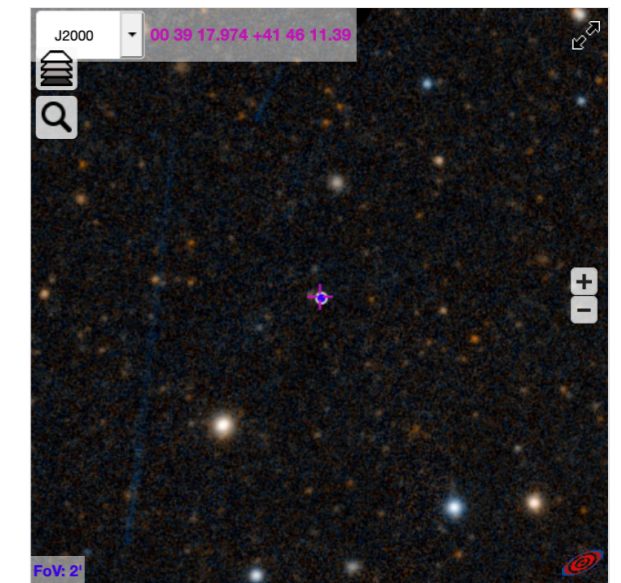
[695111200004913](#) (0.149"), [695311200081544](#) (0.264")



Different field

[1735202100076739](#) (0.074"), [1735102100005173](#) (0.224")

Aladin



CONCLUSIONS

- Our results confirm the importance of combining automatic machine learning algorithms with domain knowledge in the construction of recommendation systems for astronomy
- Anomaly detection systems must be built for experts

Thank you for attention!

