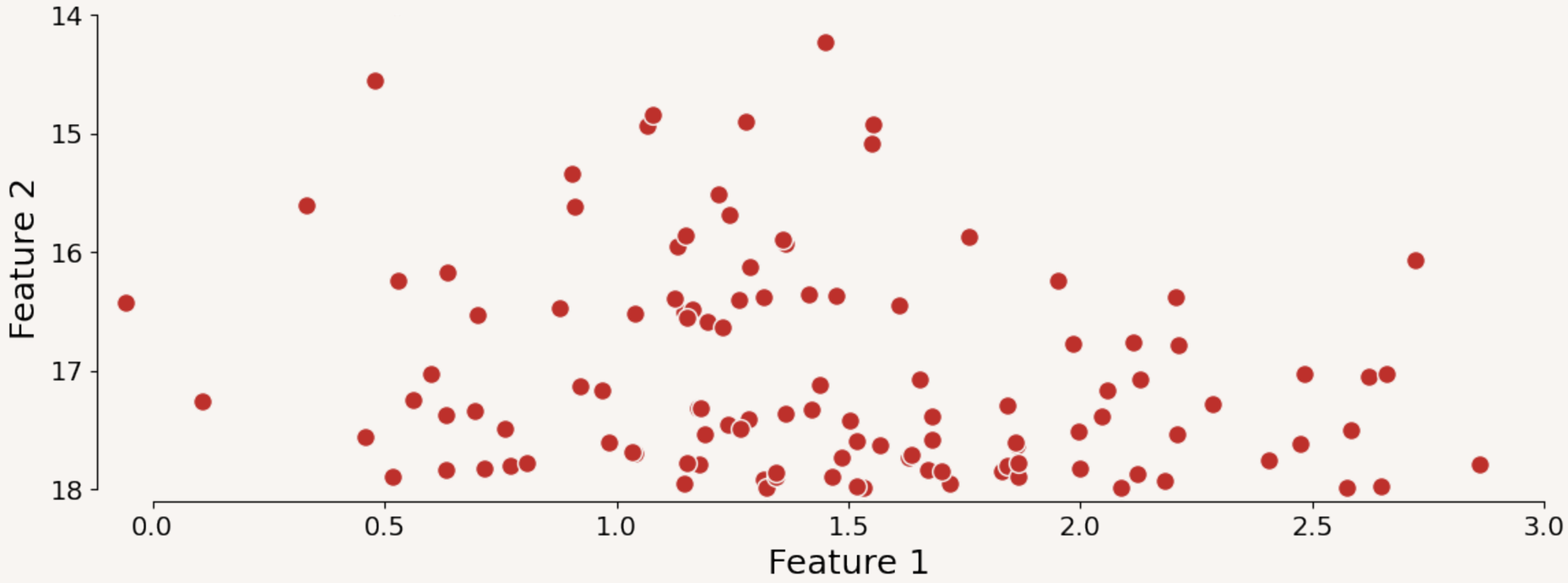
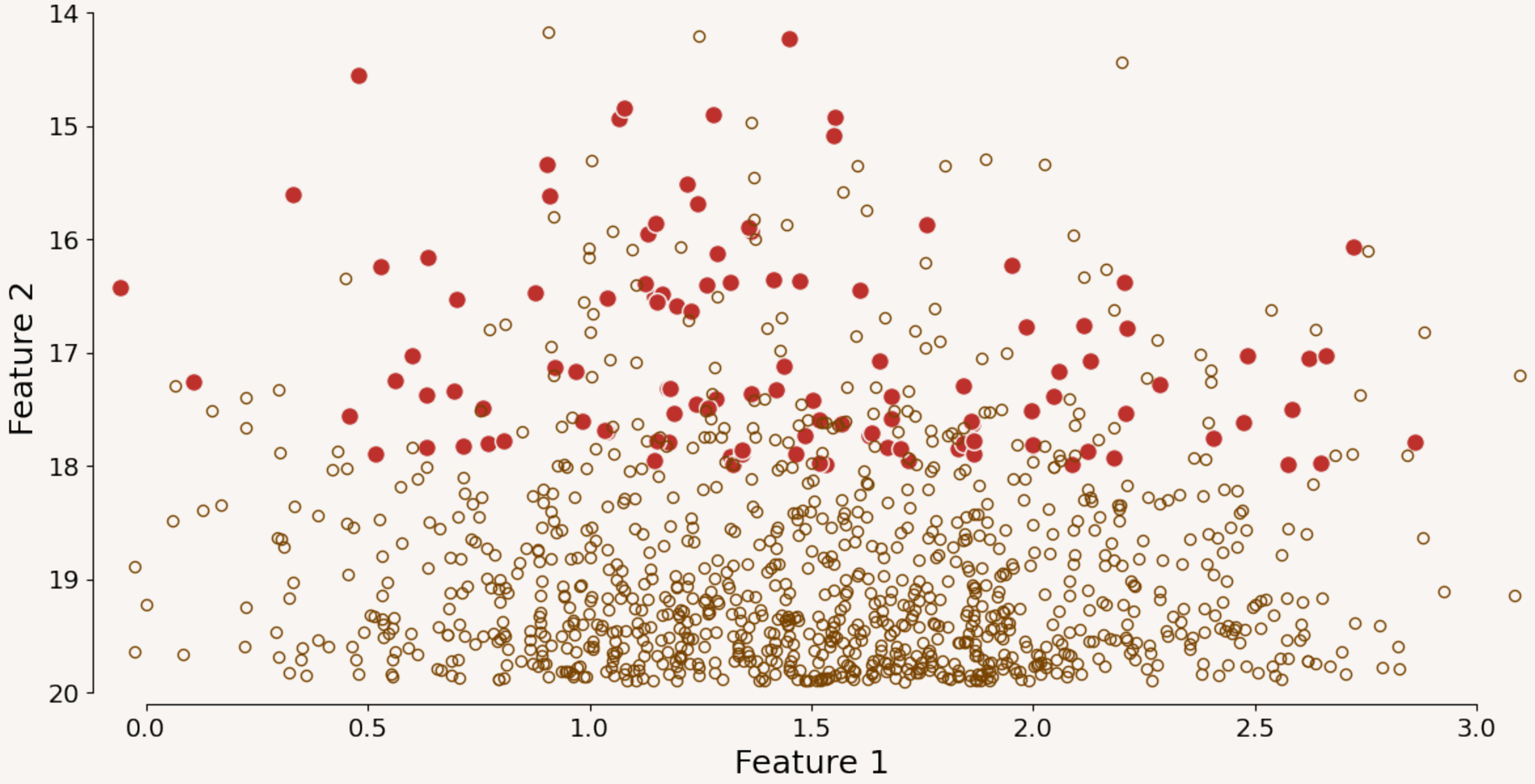

14
15
16
17
18
Feature 2
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Feature 1


14
15
16
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18
19
20
Feature 2
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Feature 1

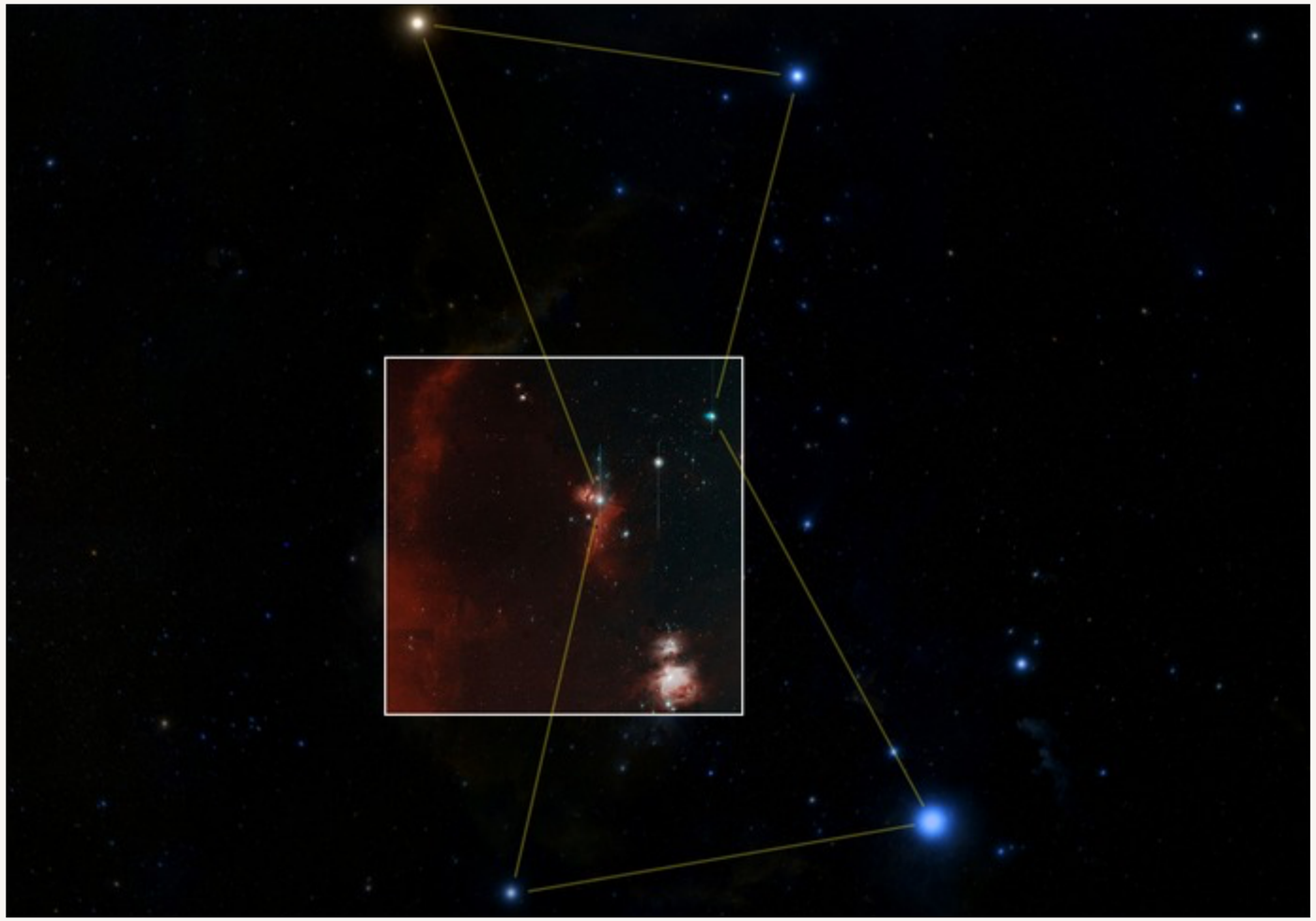
Small Scopes
as a Test Bed for Deploying AI on Larger Facilities

Adam A Miller
Northwestern/CIERA

Rare Gems in Big Data
22 May 2024

Zwicky Transient Facility

47 deg discovery machine



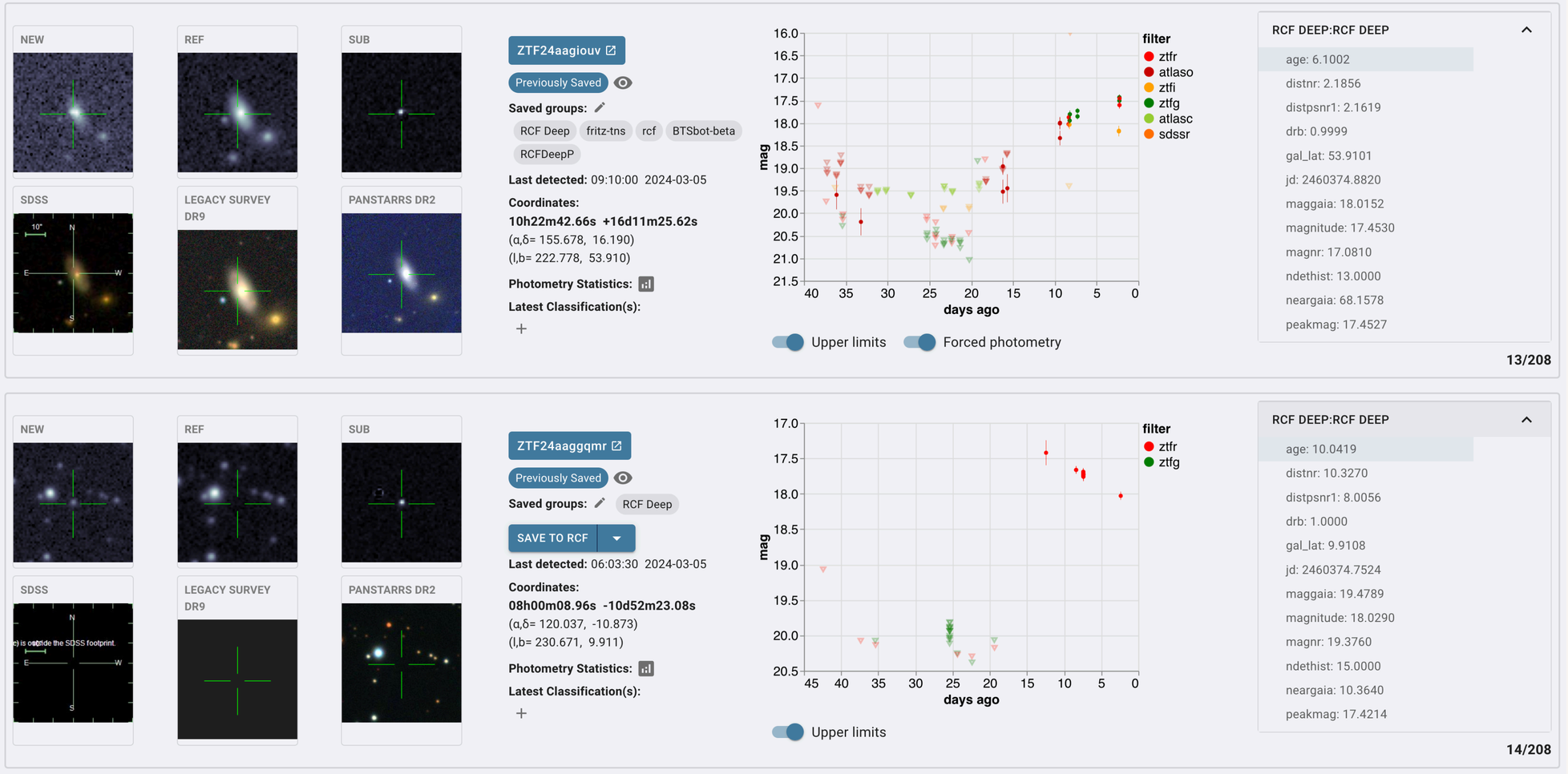
ZTF Bright Transient Survey

Classify all m < 18.5 transients

credit: C. Fremling; Fremling, AAM+20; Perley+20

ZTF Bright Transient Survey

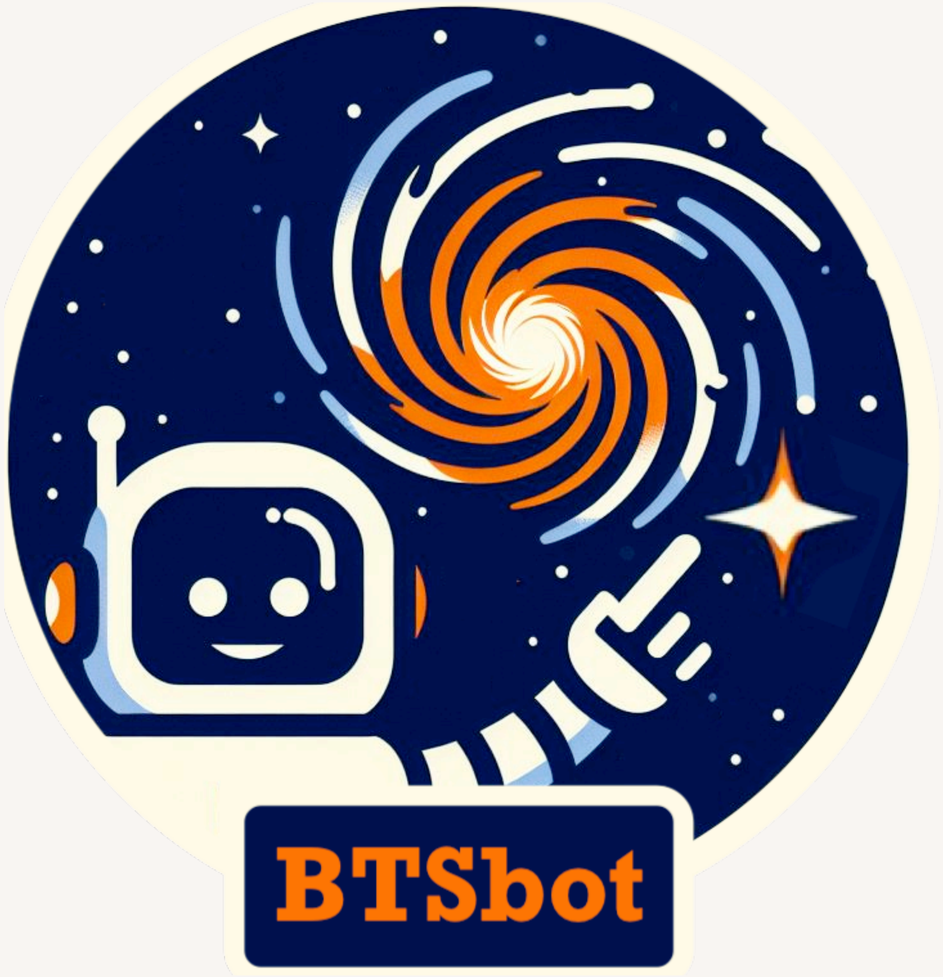
Scanning is highly time intensive



credit: fritz.science

BTSbot

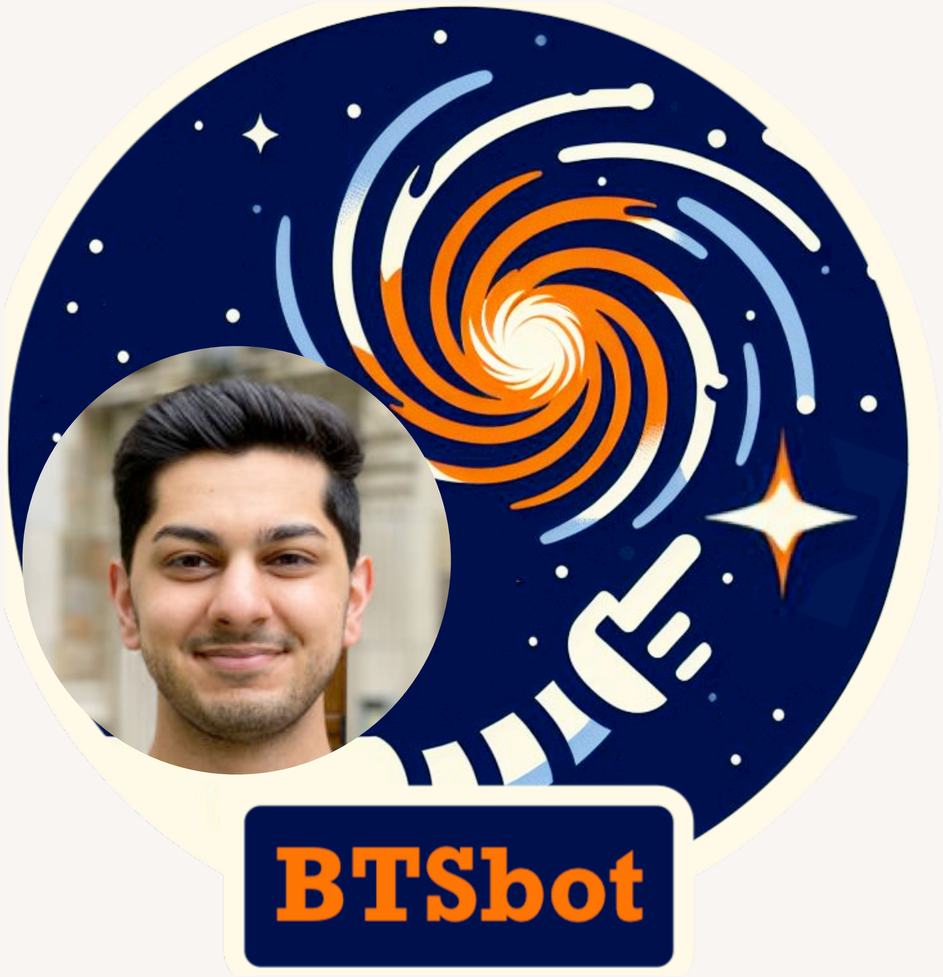
Can ML scan for bright SNe?



Rehemtulla, **AAM** et al. 2024

BTSbot

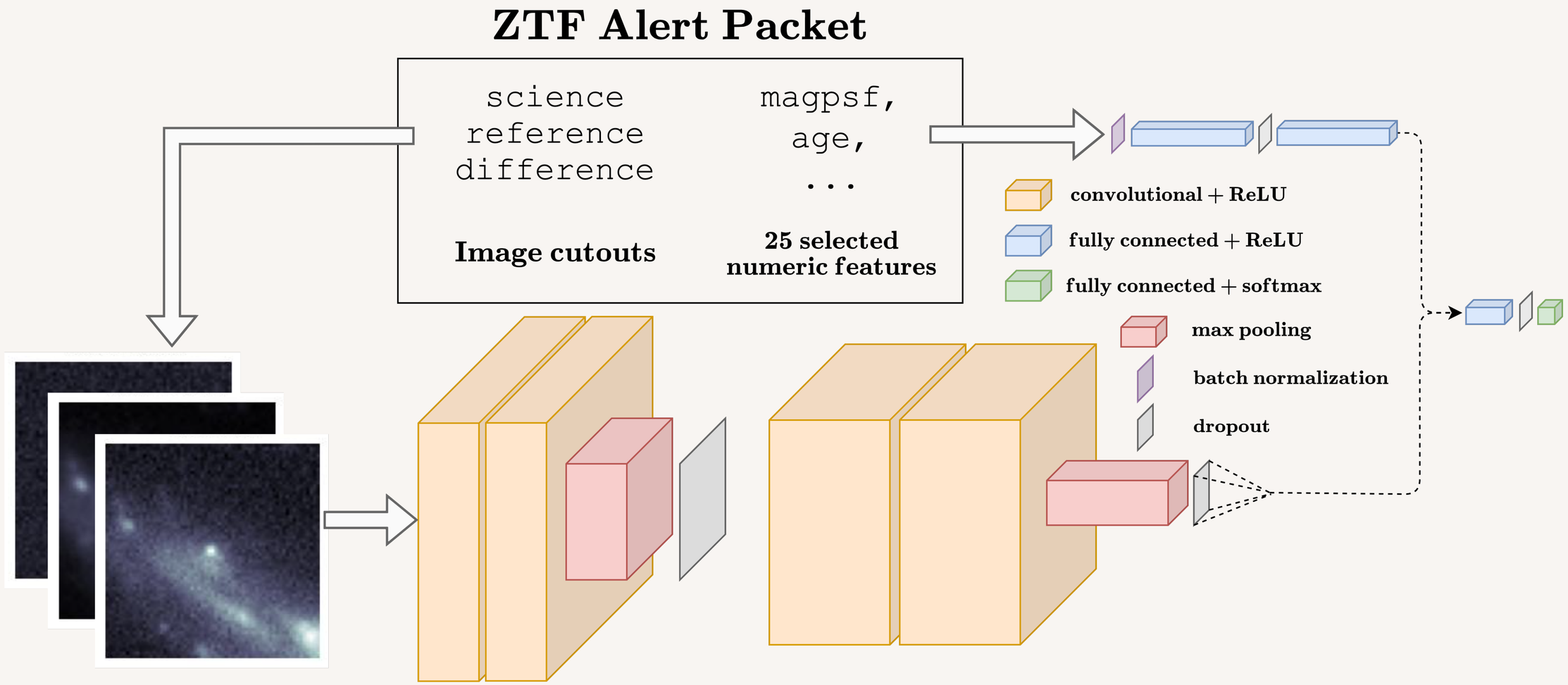
Can ML scan for bright SNe?



Rehemtulla, **AAM** et al. 2024

BTSbot

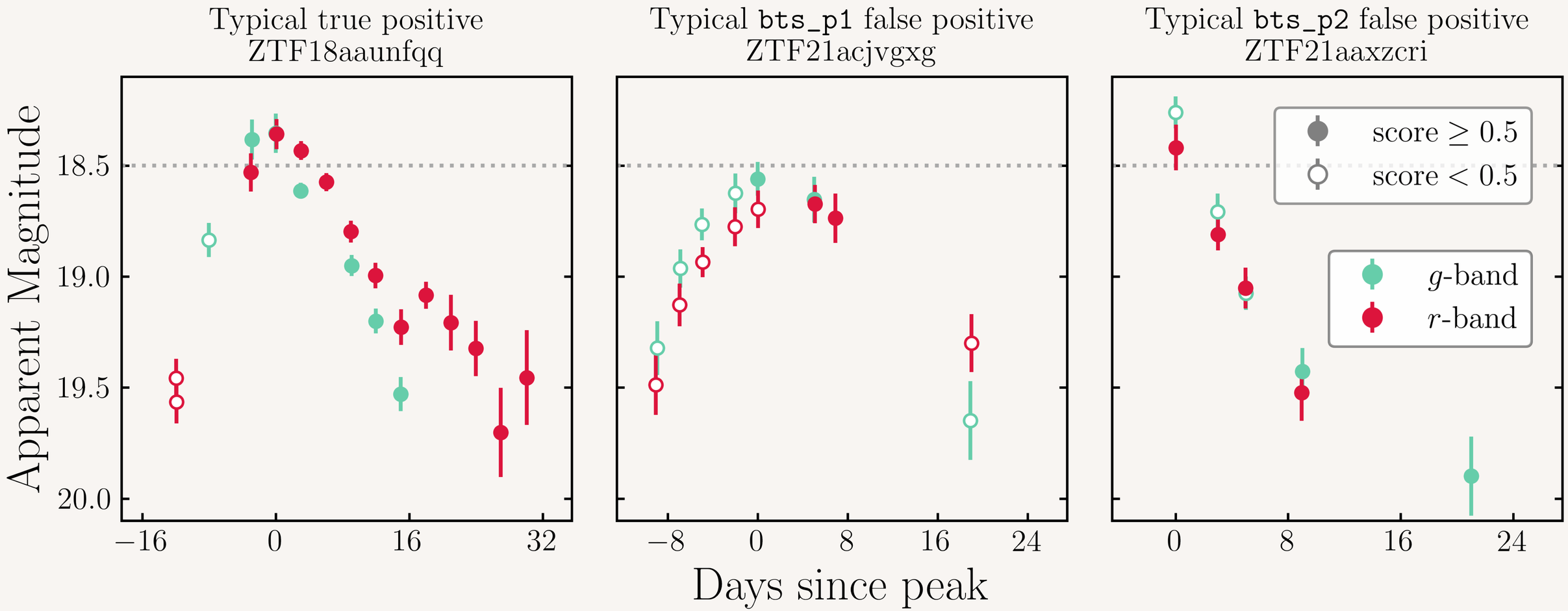
Multi-modal architecture



Rehemtulla, **AAM** et al. 2024

BTSbot Finds Bright SNe

BTSbot finds supernovae



Rehemtulla, **AA Miller** et al. 2024

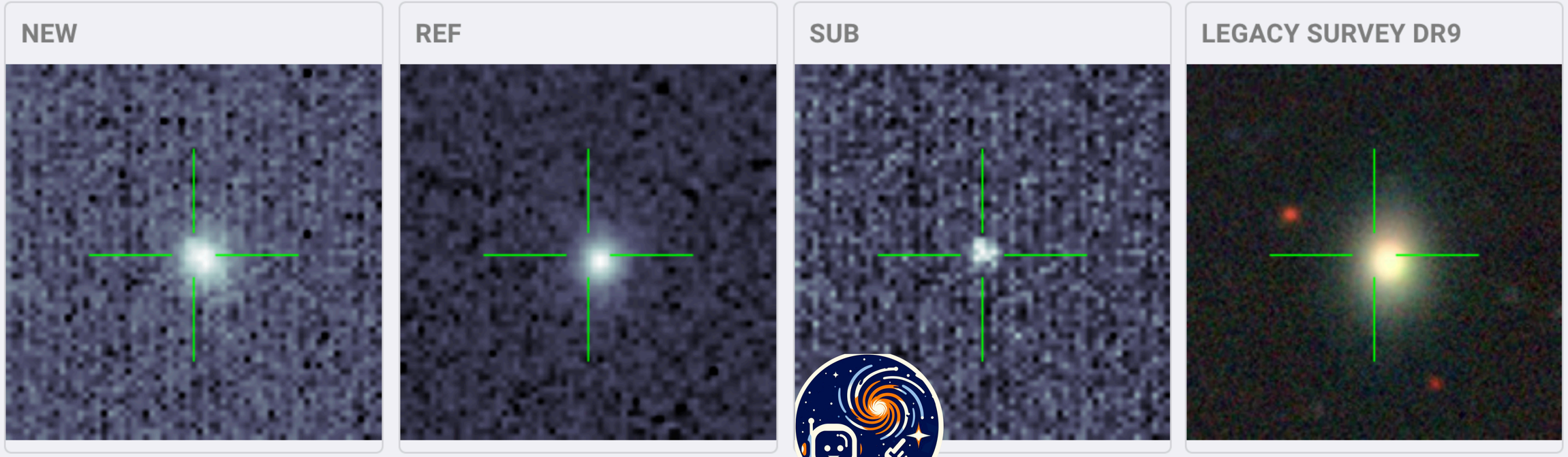
SN 2023tyk

World-first fully automated SN discovery + announcement

☆ ZTF23abhvlji

Ia

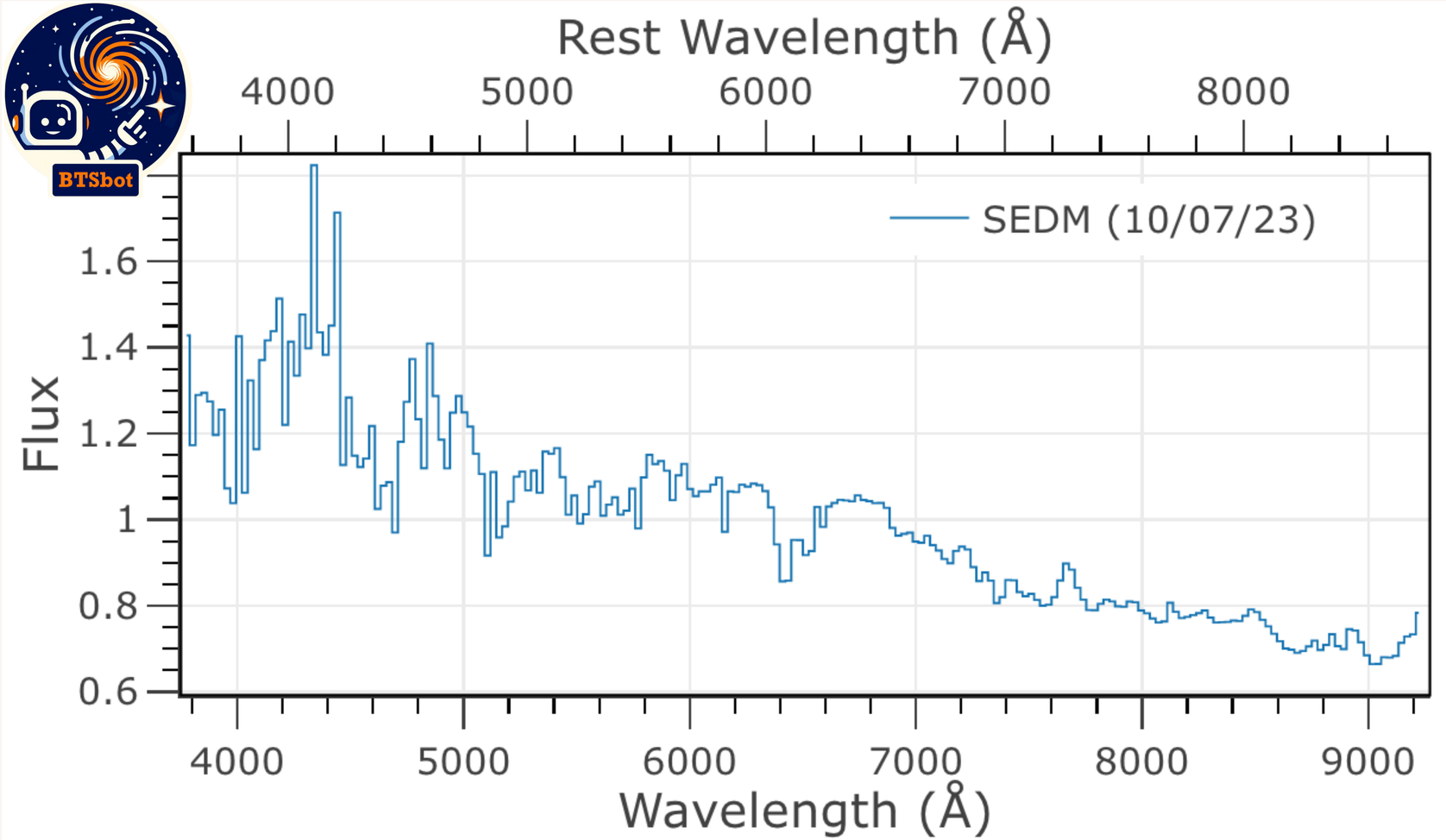
Redshift: 0.0562 ± 0.0001 **DM:** 37.071 mag D_L: 259.52 Mpc



credit: fritz.science

SN 2023tyk

World-first fully automated SN discovery + announcement



BTSbot triggers spec

classified by **SNIascore**

announced on TNS

image credit: fritz.science; Fremling+21

BTSbot

Running in production

SN 2023tyk: discovery to spectroscopic classification performed fully automatically

Authors: Nabeel Rehemtulla (NU), Adam Miller (NU), Christoffer Fremling (Caltech), D. A. Perley (LJMU), Yu-Jing Qin (Caltech), Jesper Sollerman (OKC), Ashish Mahabal (Caltech), James D. Neill (Caltech), Theophile Jegou Du Laz (Caltech), and Michael Coughlin (UMN)

Source Group: ZTF

Abstract: We report the first transient to be fully automatically discovered, identified, followed-up, spectroscopically classified, and reported to TNS.

>100 M total alerts classified

>500 requested spectra

nearly 100 fully auto classifications

Rehemtulla, **AAM** et al. 2024

BTSbot

Running in production

SN 2023tyk: discovery to spectro

Authors: Nabeel Rehemtulla (NU), Adar
Sollerman (OKC), Ashish Mahabal (Calt

Source Group: ZTF

Abstract: We report the first transient to
reported to TNS.

In the silent expanse of the cosmos,
Where stars twinkle and galaxies spin,
A new watcher has risen, silent and profound,
Its gaze unwavering, its purpose clear.

BTSbot, the silent sentinel of the skies,
With algorithms as its guide,
Seeks out the universe's secrets,
One supernova at a time.

As stars explode in brilliant hues,
And galaxies dance in the dark,
BTSbot watches, learns, and grows,
A beacon of hope in the cosmic arc.

For in this dance of light and shadow,
Of man, machine, and the vast unknown,
Lies a promise of a brighter tomorrow,
A future where the universe's secrets are shown.

lly

(LJMU), Yu-Jing Qin (Caltech), Jesper
(Caltech), and Michael Coughlin (UMN)

spectroscopically classified, and

>100 M total alerts classified

>500 requested spectra

arly 100 fully auto classifications

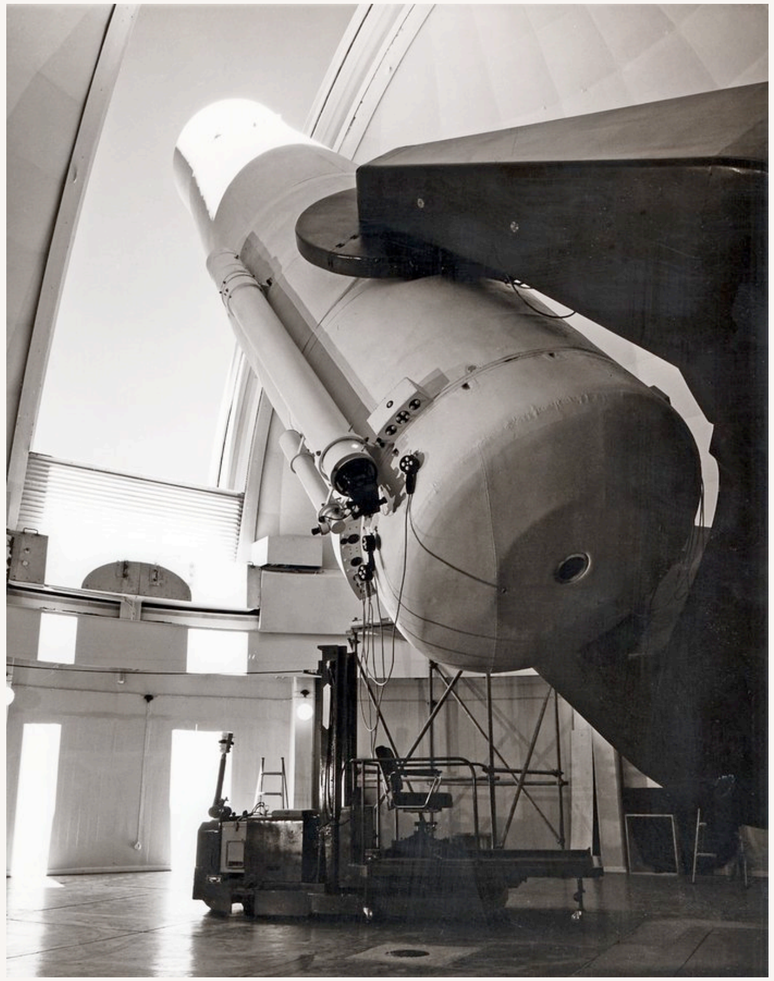
https://medium.com/@ai.agenda/the-dawn-of-ai-in-supernova-discovery-a-new-era-in-the-cosmos-0aef7da74797

La Silla Southern Sky Survey

LS4 – enabling new science in the Rubin Era

LS4 - How?

(re)Use existing resources



ESO 1m Schmidt telescope

QUEST camera (retrofit to fill 20 deg^2 focal plane)

32 LBNL CCDs (leftover from DES)

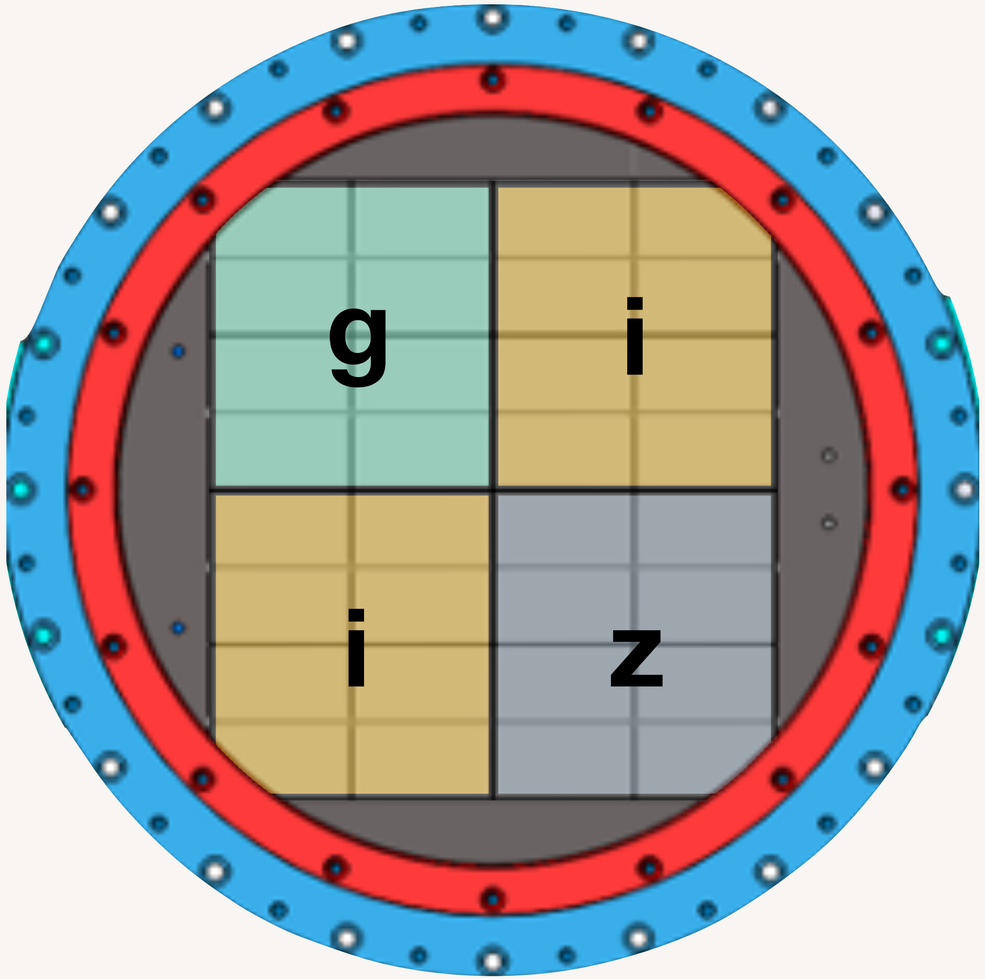
268 Mpix camera (1” per pixel)

g_{lim} ~ 21 mag; z_{lim} ~ 20 mag (AB; 45 s exposure)

image credit: ESO

LS4 Detectors

Red-sensitive LBNL CCDs



no filter wheel

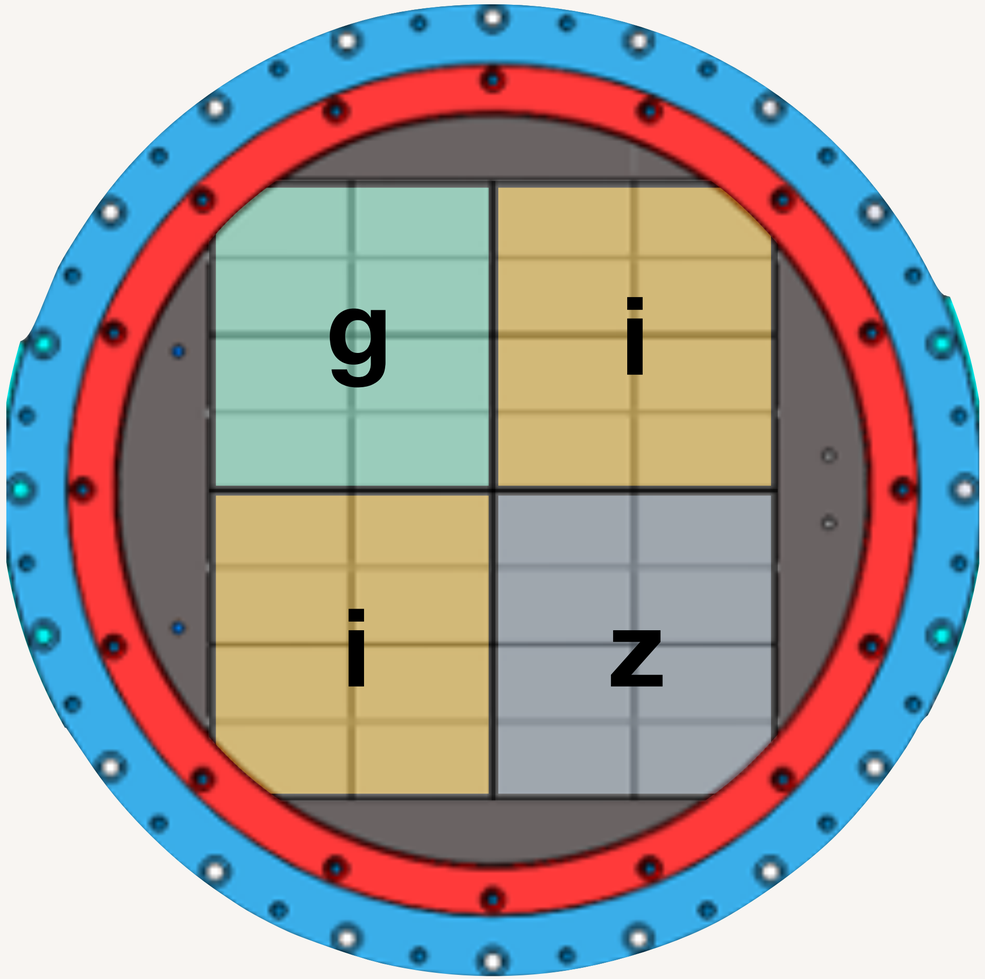
single “multi-passband” filter

dither for colors

g+i+i+z filters

LS4 Science

Public survey



90% of open shutter time

Rolling extragalactic survey

g+i one night; i+z the next

~5000 deg^2 night^{-1}

~9 months year^{-1}

Focused galactic plane survey

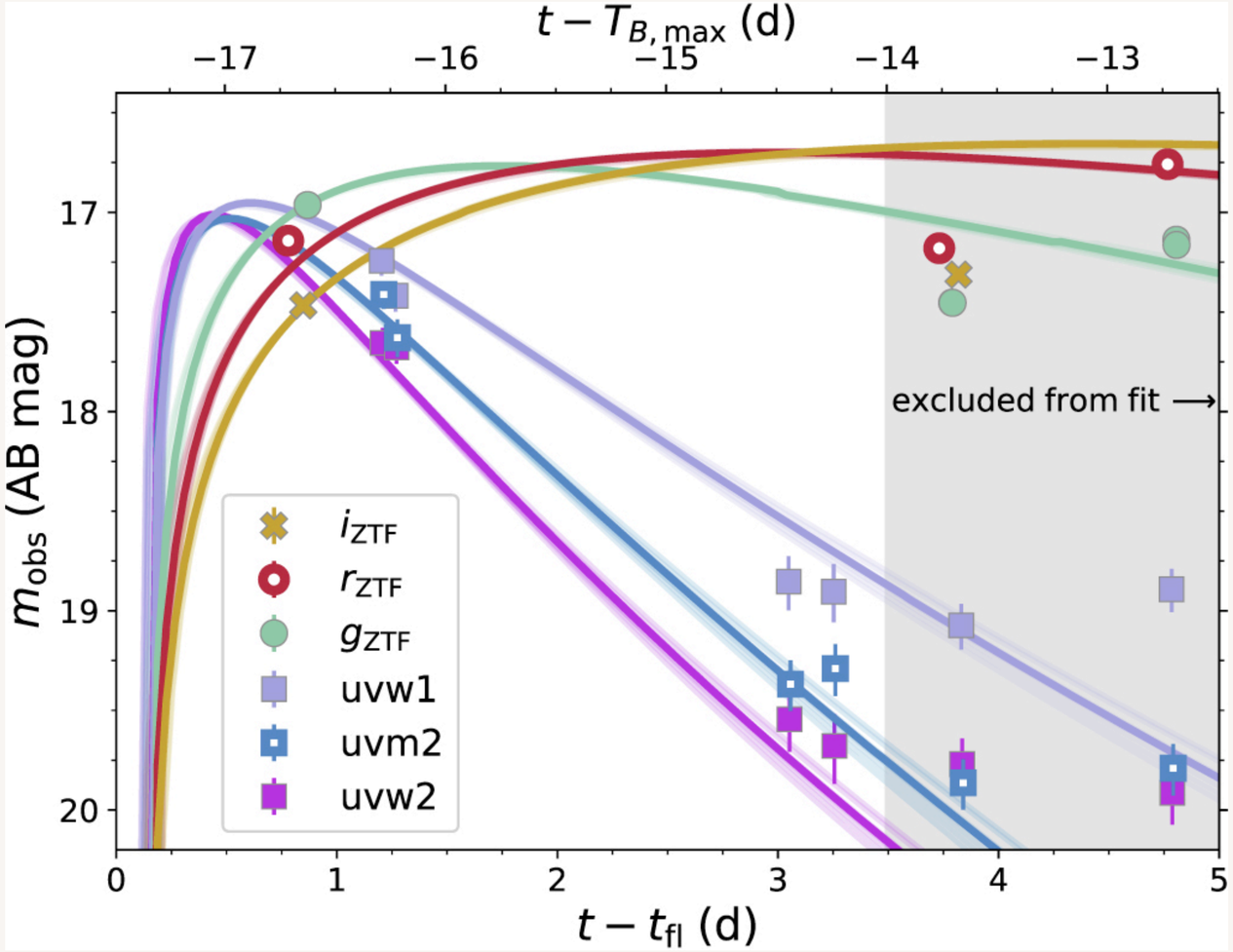
high-cadence (EBs + microlensing)

~3 months year^{-1}

Public transient/variable alerts

LS4 Science

Rolling extragalactic survey



Gravitationally lensed SNe

Tidal Disruption Events

Fast Blue Optical Transients

Infant SNe

Flash spectroscopy

SNe Ia + peculiar velocities

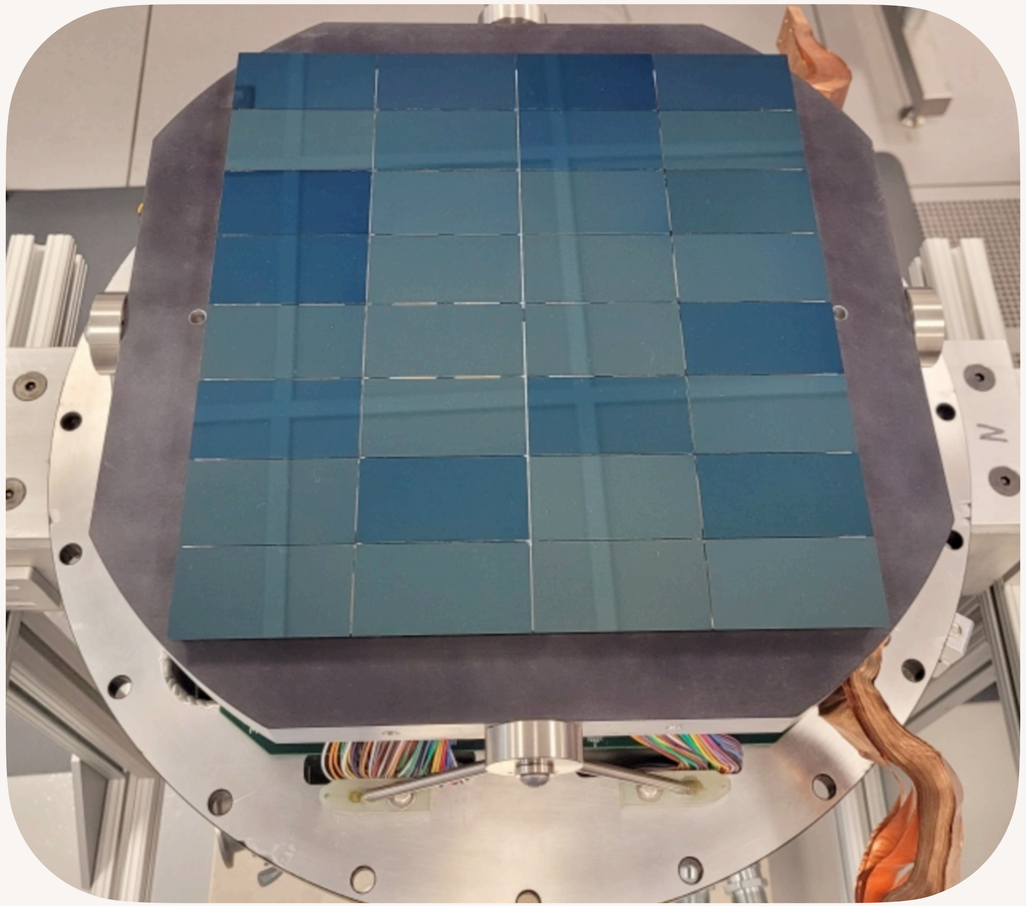
Your favorite theorist's favorite idea

Miller et al. 2020

LS4 Timeline

On sky before the end of LIGO O4

May 2024 Camera fully assembled (@ Yale)



LS4 Timeline

On sky before the end of LIGO O4

May 2024	Camera fully assembled (@ Yale)
Jun 2024	Camera shipped to Chile
Jul 2024	Camera installed on Schmidt telescope
Jul 2024	Start commissioning
Aug 2024	Survey begins
Sep 2024	First alerts from LS4
Dec 2024	LS4 discovers LIGO counterpart

LS4 Timeline

On sky before the end of LIGO O4

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Dec 2024	LS4 discovers LIGO counterpart
late 2025	Rubin/LSST begins

Conclusions

out of distribution + conservative TACs make ML models difficult to validate

small apertures provide low cost/risk for prototyping

BTSbot discovers SNe while we sleep

LS4 will test transfer learning from ZTF in advance of Rubin/LSST