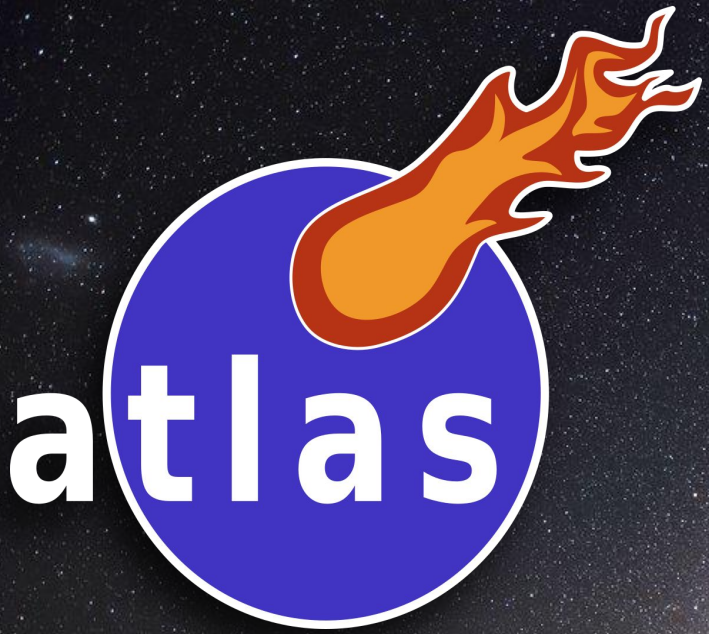
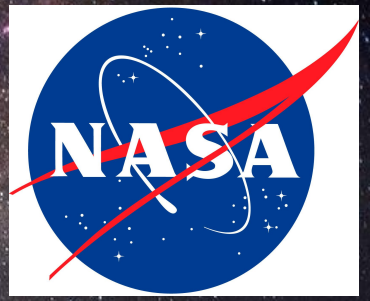


(the) Asteroid Terrestrial-impact Last Alert System

Heloise F. Stevance
(Schmidt A.I. in Science Fellow)
on behalf of the ATLAS team



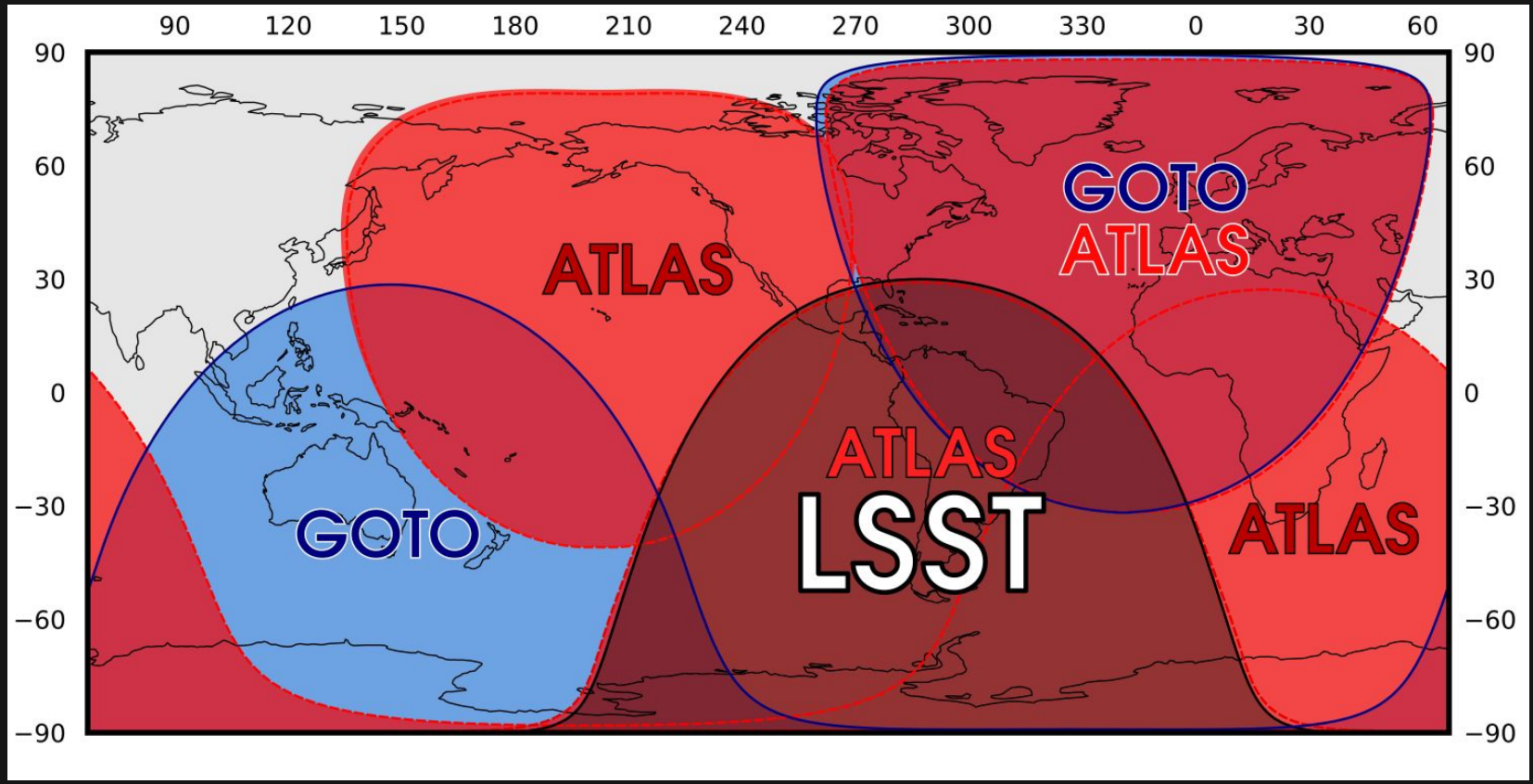
Schmidt Sciences

hfstevance@gmail.com

The Specs: Geography

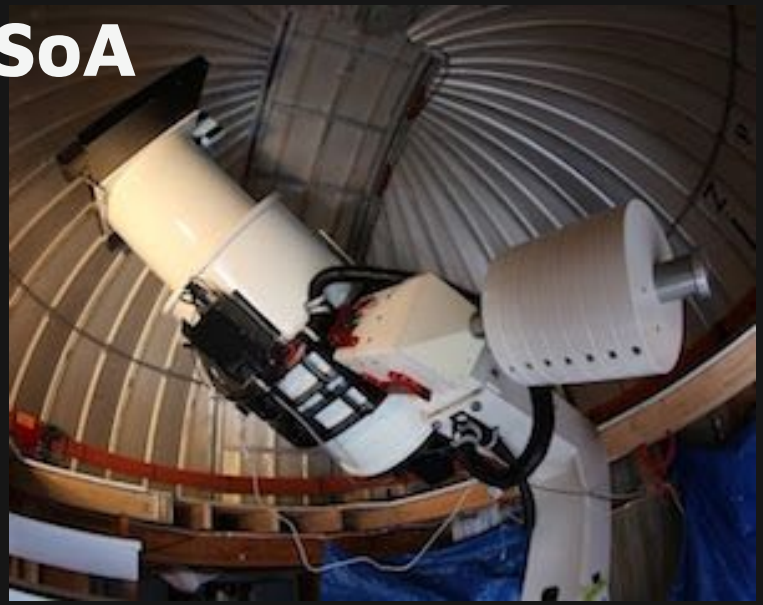
5 units: Hawaii x2, Chile, Tenerife, South Africa

The Specs: Geography



The Specs: Telescopes

Hawaii, Chile, SoA



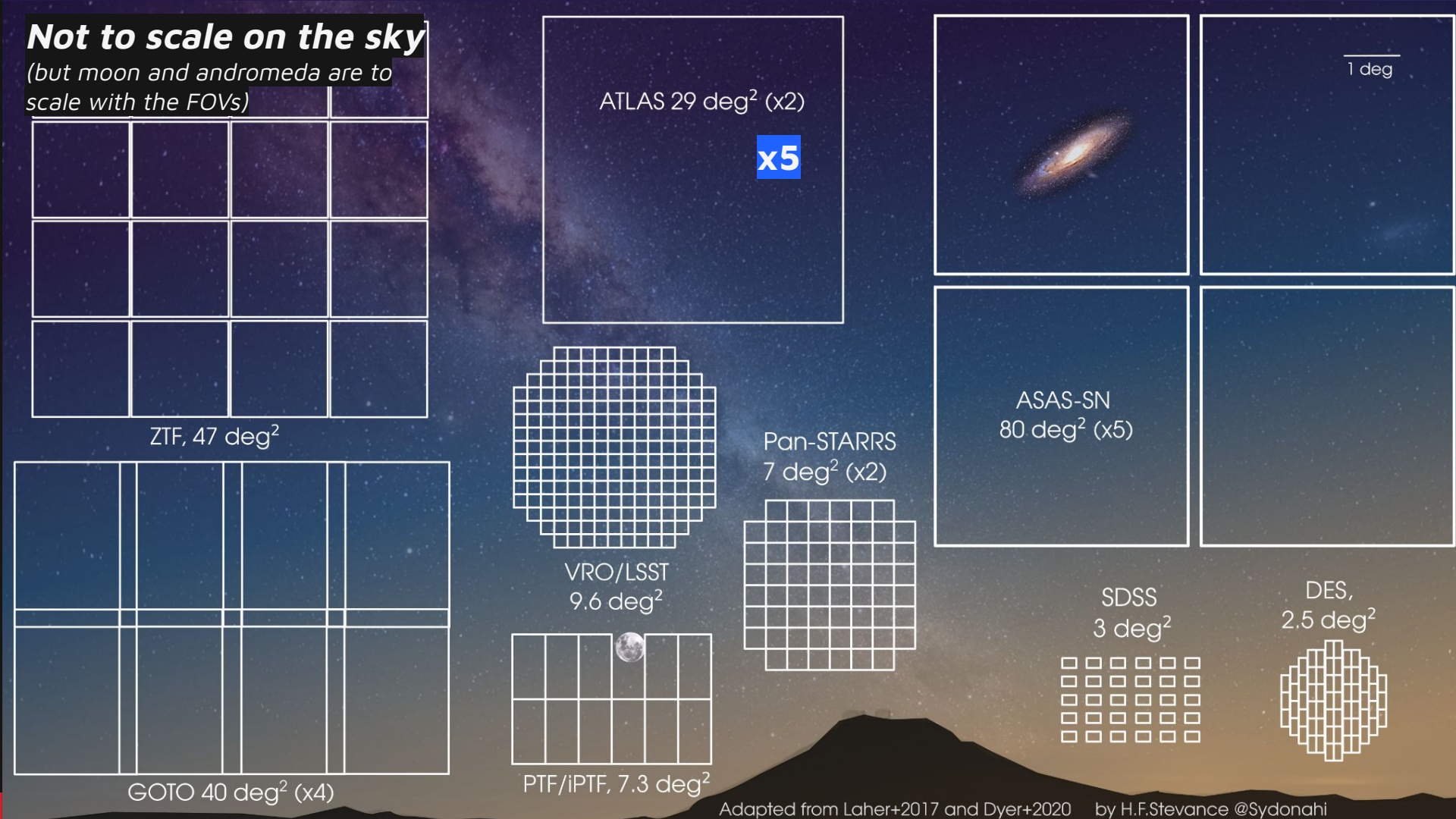
D: 50cm | FOV: 7.4° | CCD

https://arxiv.org/pdf/1802.00879

Tenerife

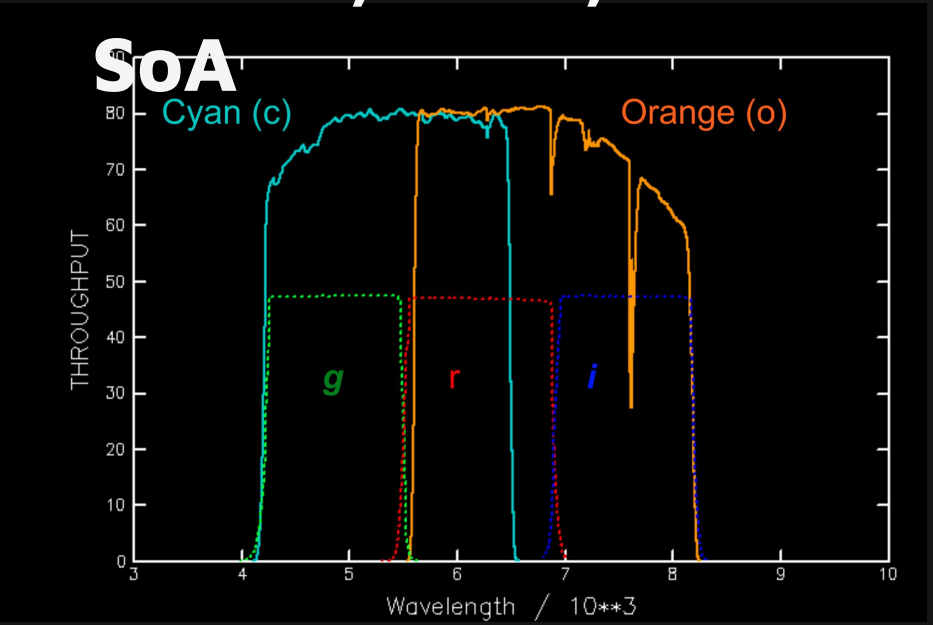
D: 56cm | FOV: 7.3° | CMOS

https://arxiv.org/pdf/2302.07954

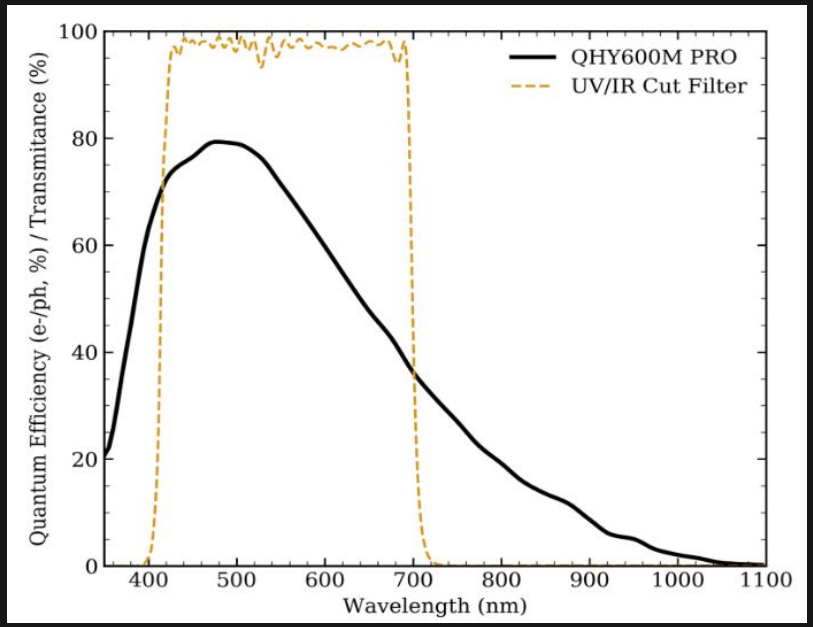

Not to scale on the sky
(but moon and andromeda are to scale with the FOVs)
ATLAS 29 deg² (x2)
x5
1 deg
ZTF, 47 deg²
ASAS-SN
80 deg² (x5)
VRO/LSST
9.6 deg²
Pan-STARRS
7 deg² (x2)
SDSS
3 deg²
DES,
2.5 deg²
GOTO 40 deg² (x4)
PTF/iPTF, 7.3 deg²
Adapted from Laher+2017 and Dyer+2020 by H.F.Stevance @Sydonahi

The Specs: The filters

Hawaii, Chile, SoA



Tenerife

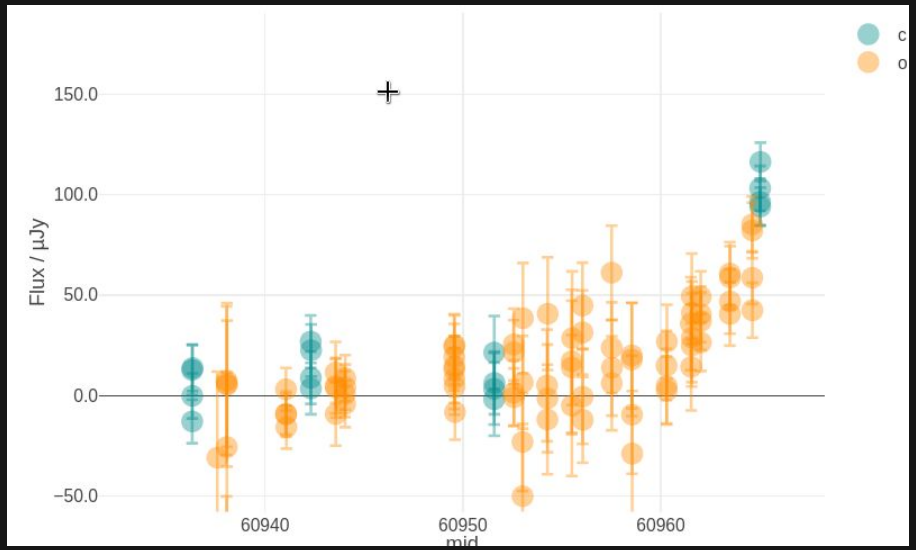


The Specs: Observation strategy

4x30sec separated by 15 minutes

Orange and cyan filter

(on different observation streaks - you won't have 2 in o and 2 in c)



The Main goal is discovery and follow up of SSOs ***<20 meters: several days out | 100 meters: several weeks out*** *- (led by another team)*

Cadence

24 to 48h

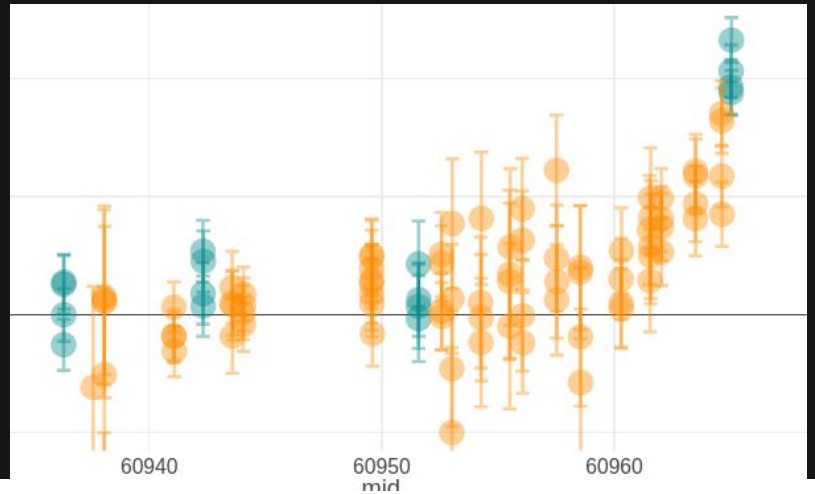
hfstevance@gmail.com

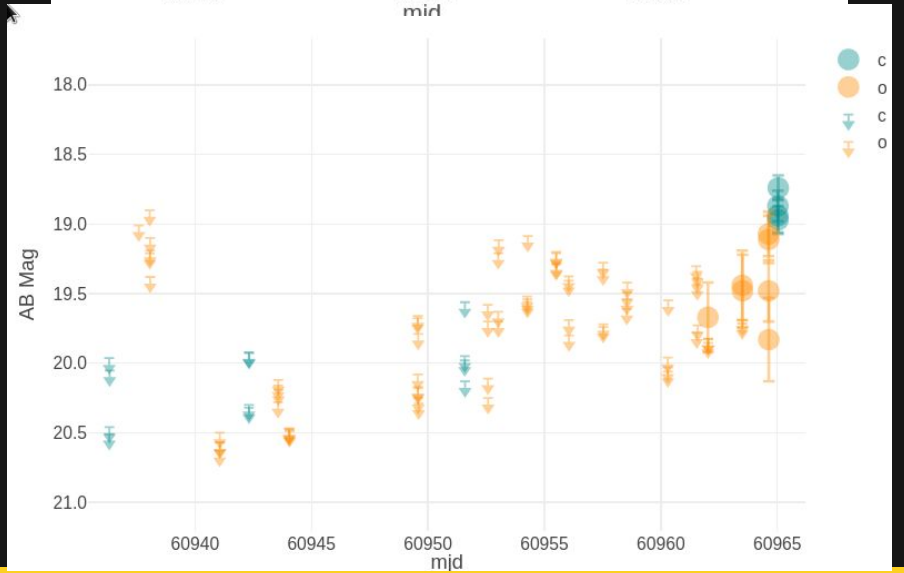
The Specs:
Magnitude limits

19.7 (AB mag) for cyan and orange
(5 sigma detection for 30 sec exp.time)

20.2 (AB mag) for 4 stacked shots

Saturation: ~12.5 mag





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Comet 3I/ ATLAS

NASA missions are working together to track and study this rare, interstellar comet as it passes through our solar system.

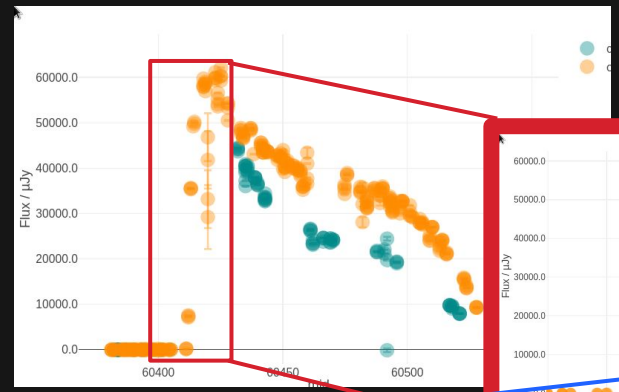
SN 2024ggi

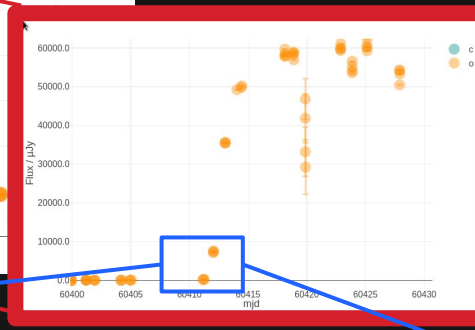
RA/DEC (2000)	Type	Redshift
11:18:22.087 -32:50:15.27	**SN II**	**0.002435**
169.592030529 -32.8375756395		

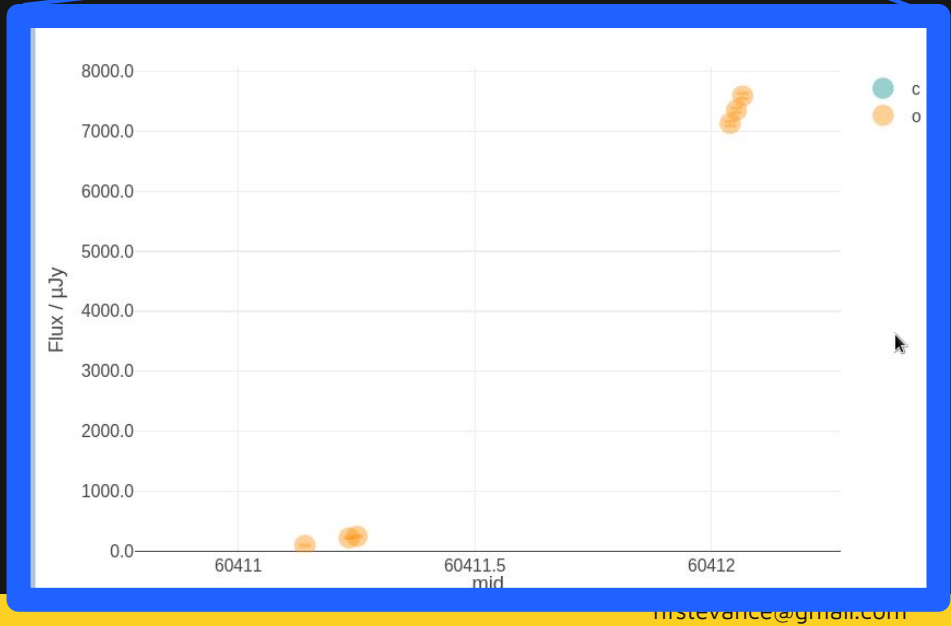
Discovery Report Classification Report

Related AstroNotes: 2024-100 , 2024-102 , 2024-103 , 2024-104 , 2024-101 , 2024-105 , 2024-107 , 2024-109 , 2024-108 , 2025-21 , 2025-22

Reporting Group	Discovering Data Source	Discovery Date	TNS AT	Public	Discovery Mag
ATLAS	**ATLAS**	**2024-04-11 03:22:35.616**	**Y**	**Y**	**18.915**







Alert Handling in the ATLAS Transient Web Server

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Kilonova

Supernovae

Tidal Disruption Events

Active Galactic Nucleus

Cataclysmic Variables

pace-art.co.uk / strictly no unauthorised use

Asteroids, Comets (SSOs)

hfstevance@gmail.com

DATA PROCESSING

Data reduction
on-site

Difference imaging
Centralised in Hawaii

Data sent to QUB

References
Smith et al. 2021

Alert Processing

1) **Quality cuts:**
   5 sigma detection in 3 out of 4 exposures
2) Match to existing source or give new ID
3) **X-match with catalogues (Sherlock)**
4) Remove Variable stars
   (data NOT deleted - just removed from pile of transient alerts)
5) **Real bogus classifier**
6) **Prioritise (VRA)**

EYEBALLERS

Ken Smith
k.w.smith@qub.ac.uk

SHERLOCK

Cross-matches alert position to astrophysical catalogues

Sherlock Classes

Variable Star
Cataclysmic Variables
Bright Star
Active Galactic Nucleus

Known variability

Nuclear Transient
Supernova

Orphan
Unclear

Associated with galaxy.
Offset w.r.t nucleus determines class

+ annotates alerts with possible GW associations

References

GitHub

Smith et al. 2021
(p9)

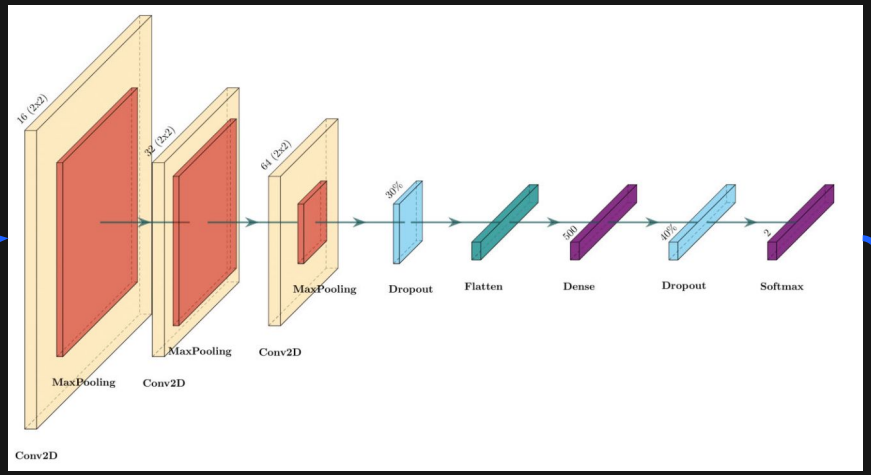
Dave Young

d.r.young@qub.ac.uk

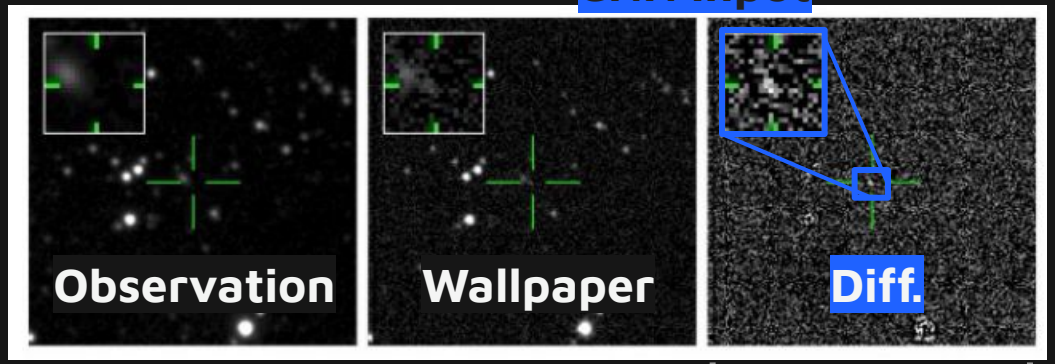
REAL/BOGUS

Reference: Weston et al. 2024

Josh Weston
jweston04@qub.ac.uk



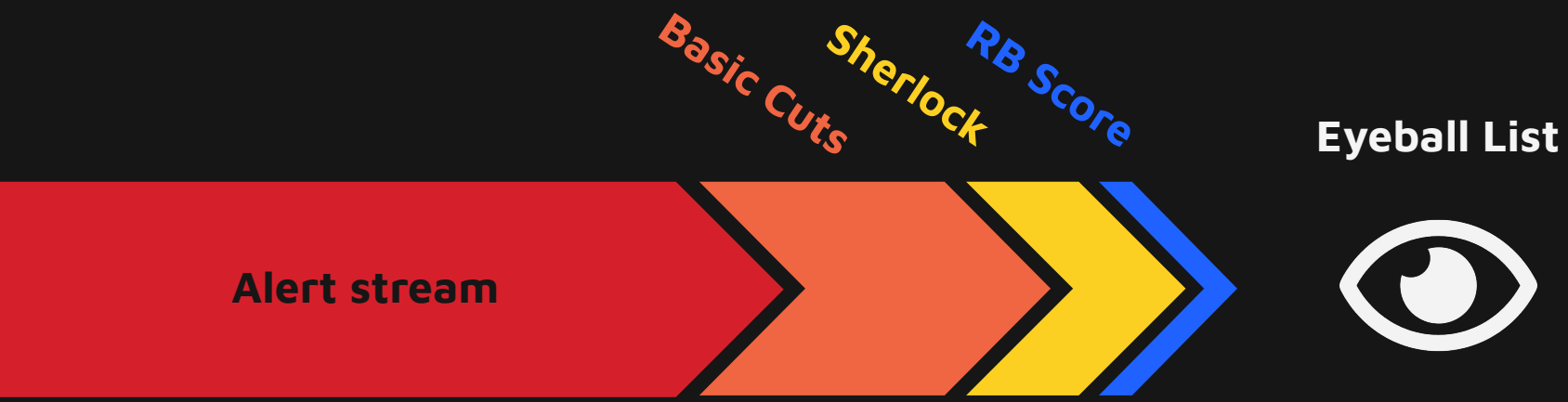
CNN input



Full size stamps

Score between 0 (bogus) and 1 (real)

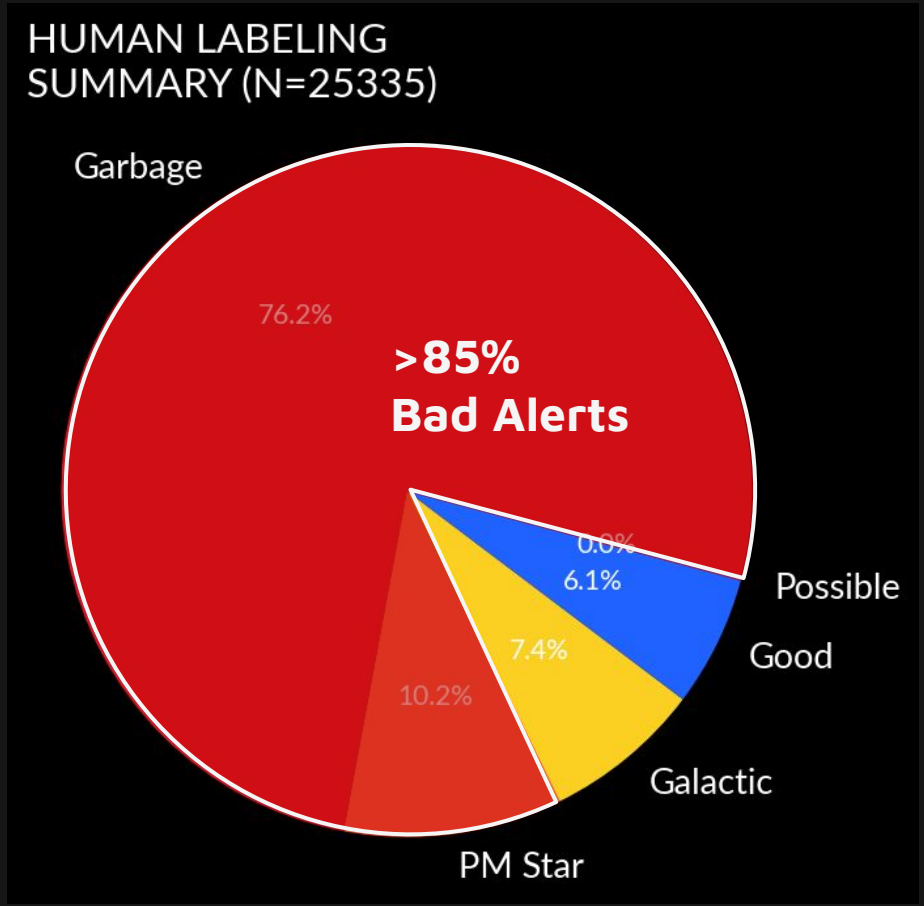
<0.2 → Garbage



Eyeball
Everything
Everytime

hfstevance@gmail.com

A lot of garbage left to eyeball



Data set gathered between 27 March and 18th July 2024

hfstevance@gmail.com

https://arxiv.org/abs/2506.09778

VIRTUAL RESEARCH ASSISTANT

Features
- Sky location
- Light curve features
- Sherlock context
- Real Bogus Score

Histogram based Gradient Boosted Decision Trees

> Scores and Ranks alerts
> Updates when new data
> Auto-garbages bad alerts

5-50

Workload Reduced by

~85%

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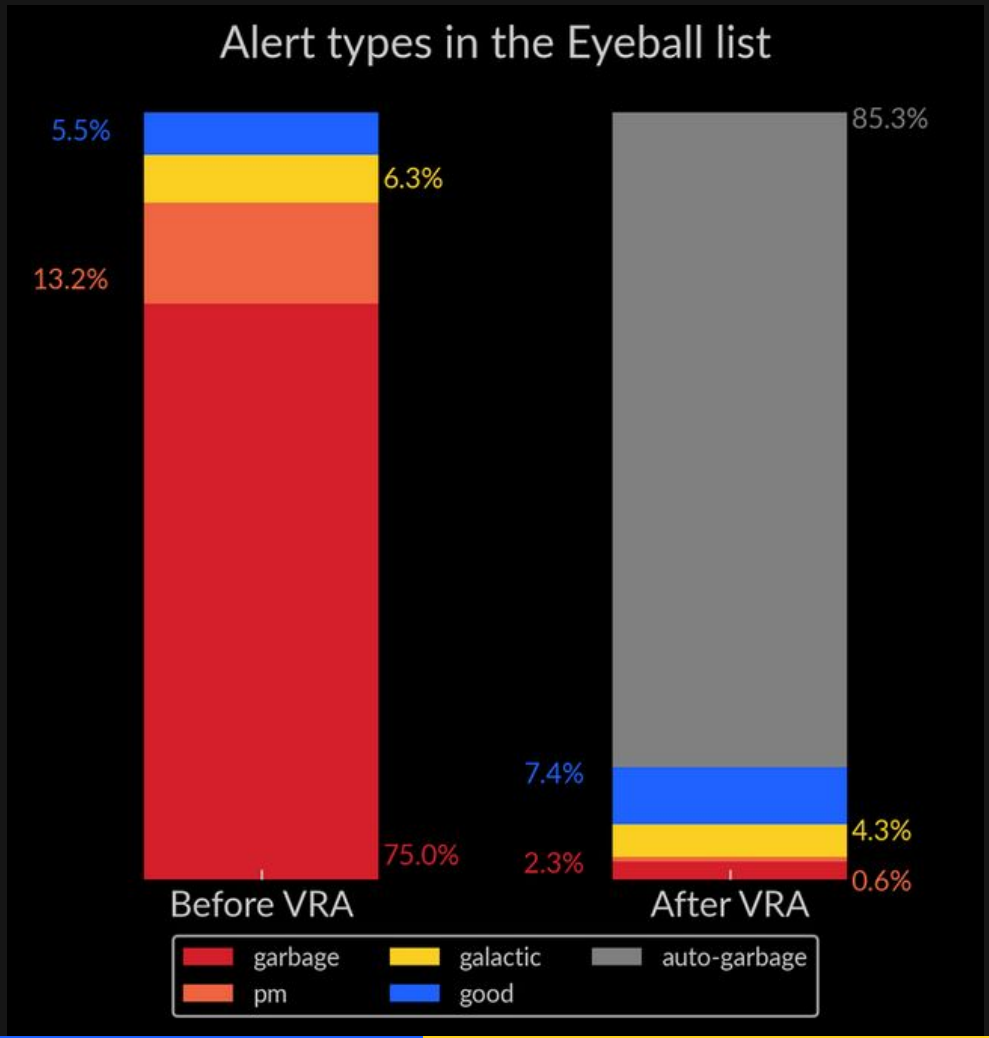
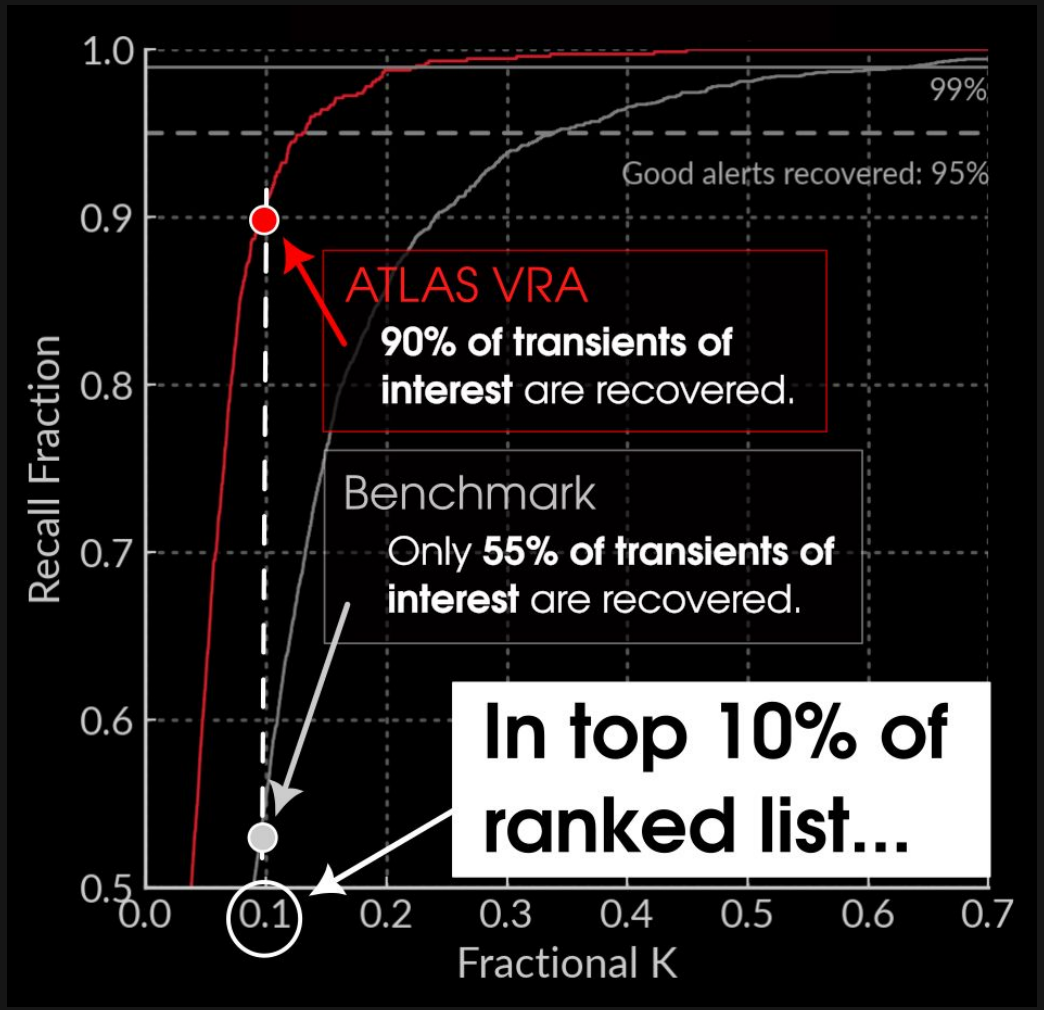

Alert types in the Eyeball list
5.5%
6.3%
13.2%
75.0%
Before VRA
85.3%
7.4%
4.3%
2.3%
0.6%
After VRA
garbage
pm
galactic
good
auto-garbage

What has made the biggest difference is **being able to reliably ORDER the list!**



How can you access the data?

https://fallingstar-data.com/forcedphot/

PUBLIC

atlas

Home Output Queue API API Guide FAQ Stats & Issues Register Log in

2025-05-01 13:22 UTC: The reboot is complete. Normal operation has resumed.

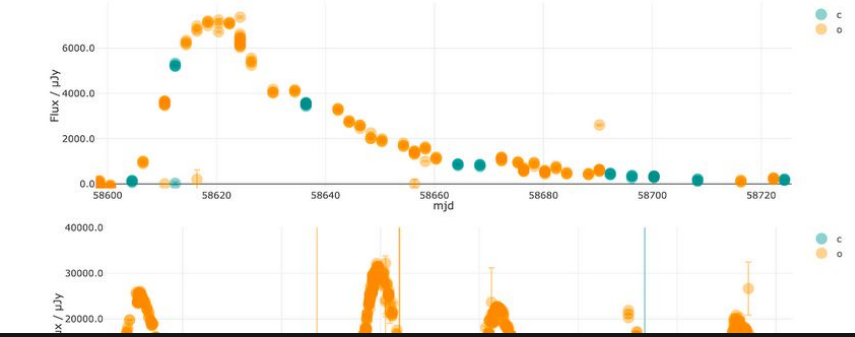
Forced photometry is now available from the Southern Telescopes (El Sauce, Chile and Sutherland, South Africa). Please be aware that the difference imaging template south of -50 degrees declination was changed during commissioning, so you may get an unexpected discontinuity in your target's difference lightcurve.

ATLAS Forced Photometry

This is the ATLAS forced photometry server, which provides full public access to photometric measurements over the full history of ATLAS survey. After registration, a user can request forced photometry at any position on the sky either for a single position, a list of positions, or moving objects (by MPC name).

ATLAS is a quadruple 0.5m telescope system with two units in Hawaii (Haleakala and Mauna Loa), and one each in Chile (El Sauce) and South Africa (Sutherland). With the installation of the two southern units, we are robotically surveying the whole sky with a cadence of 1 day between -50 and +50 and 2 days in the polar regions, weather permitting. Two filters are used, cyan and orange (denoted c and o; all mags quoted are in the AB system).

As described in Tonry et al. (2018), ATLAS surveys the whole visible sky. On each night, a sequence of 4 x 30 second exposures are taken, spaced over a period of about one hour to provide identification and orbit constraints for near-earth objects (NEOs). Discovery of NEOs and potentially hazardous objects is the main purpose of ATLAS. However the all-sky, frequent coverage, to o ~ 19.5 makes it treasure trove for time domain science. A full description is on the ATLAS homepage at fallingstar.com



https://github.com/HeloiseS/atlasapiclient

README BSD-3-Clause license

ATLAS API Client

DOI 10.5281/zenodo.15411580 JOSS Submitted

ACCESS NEEDED

Who/what is this code for?

This package allows authorised users of the ATLAS Transient web server to query the server without being exposed to regular or code breaking changes to the underlying API. In particular we have in mind **bots** and other **automated services**.

It also allows users the make routine queries in a friendlier way, such as:

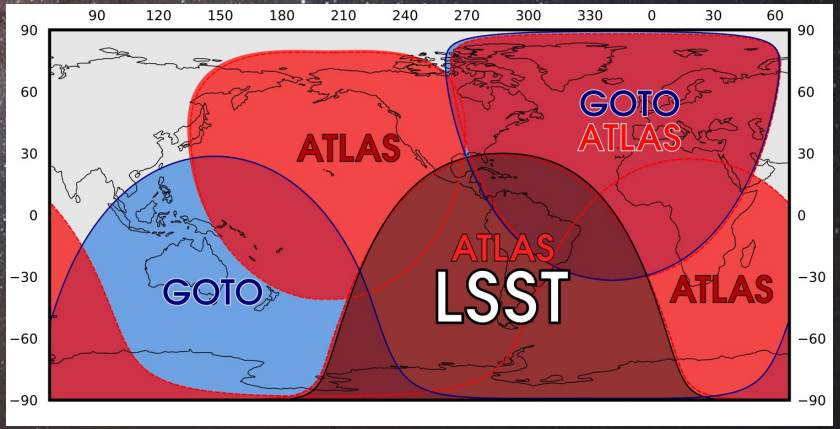
- doing a **Cone Search**
- check out the data in **your custom list**

atlas

Mag limit ~19.5

Cadence: 24h

LSST footprint fully covered!



THANK YOU!

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Extra Credit: AI for Science

Keys to Success and Scientific legacy

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Key to success

Science driven design

What data is available to you?

What metrics reflect your goals?

What is your benchmark?

➡ *Not necessarily ML!*

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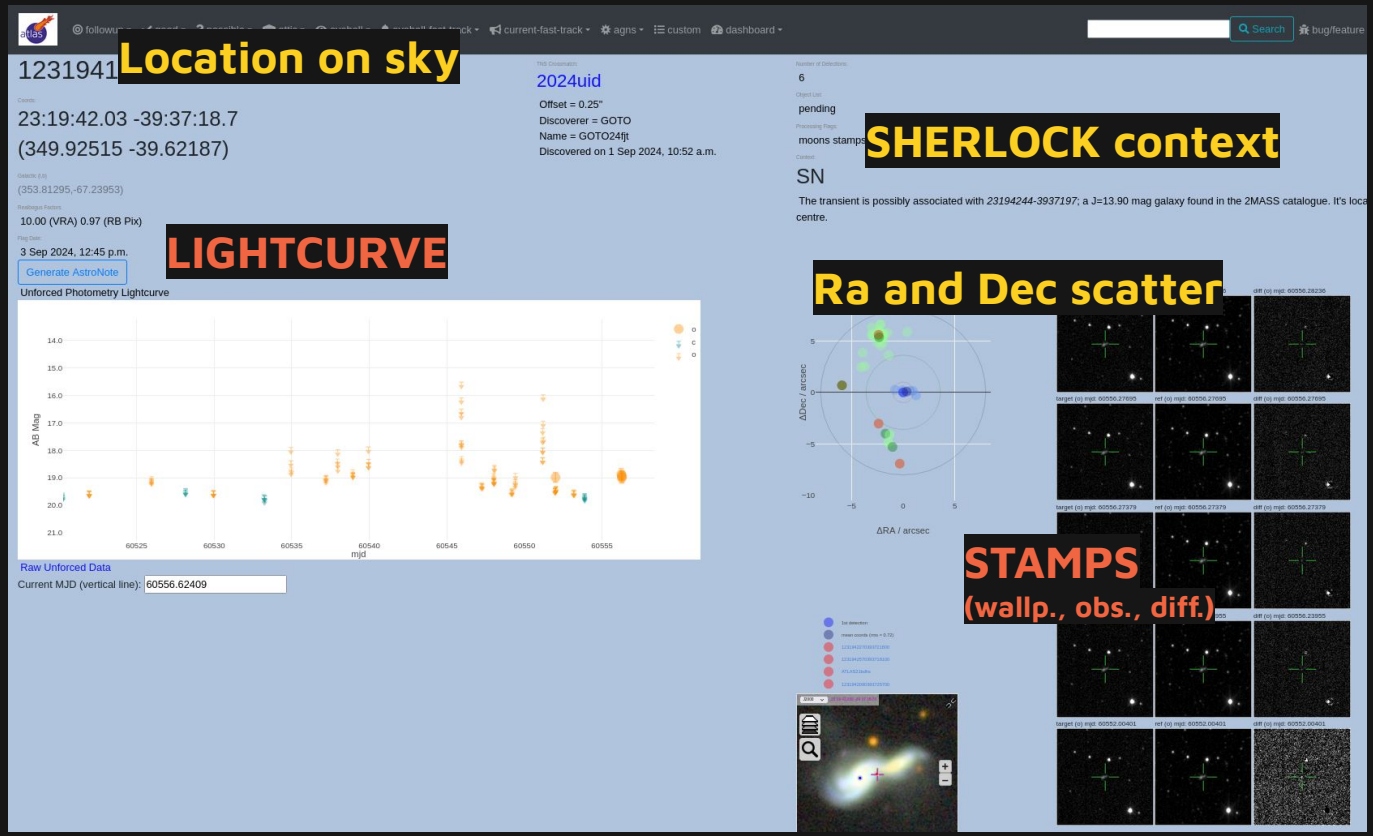
What data?

EYEBALLING

Is it Real?

Is it Galactic?



What data?

Images → Already handled by CNN upstream → **Float**

Coordinates → **Float**

Context → Sentences built from host, sep., redshift → **Floats**

Lightcurve → Messy time series
→ **Extract Features** → **Floats**

$$N \sim 10^2 - 10^4$$

What questions? What Models?

Is it Real?

Is it Galactic?

} Binary Classifiers

Histogram Based Gradient Boosted DT

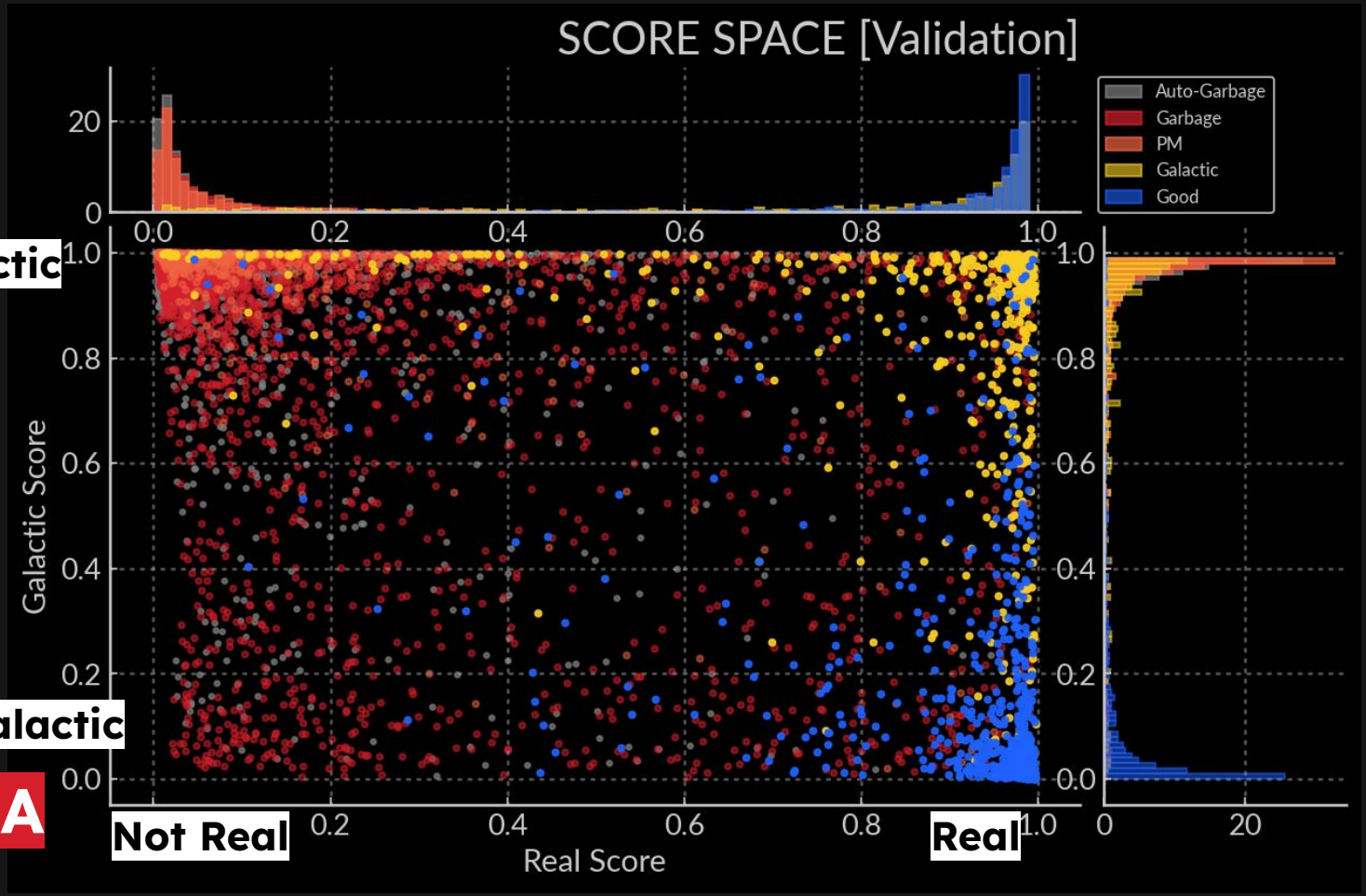
a. Feature-based → Data Thrifty
   → Interpretable + can add my expertise

b. Meaningful NaN

Bigger or more complex models are NOT SMARTER.

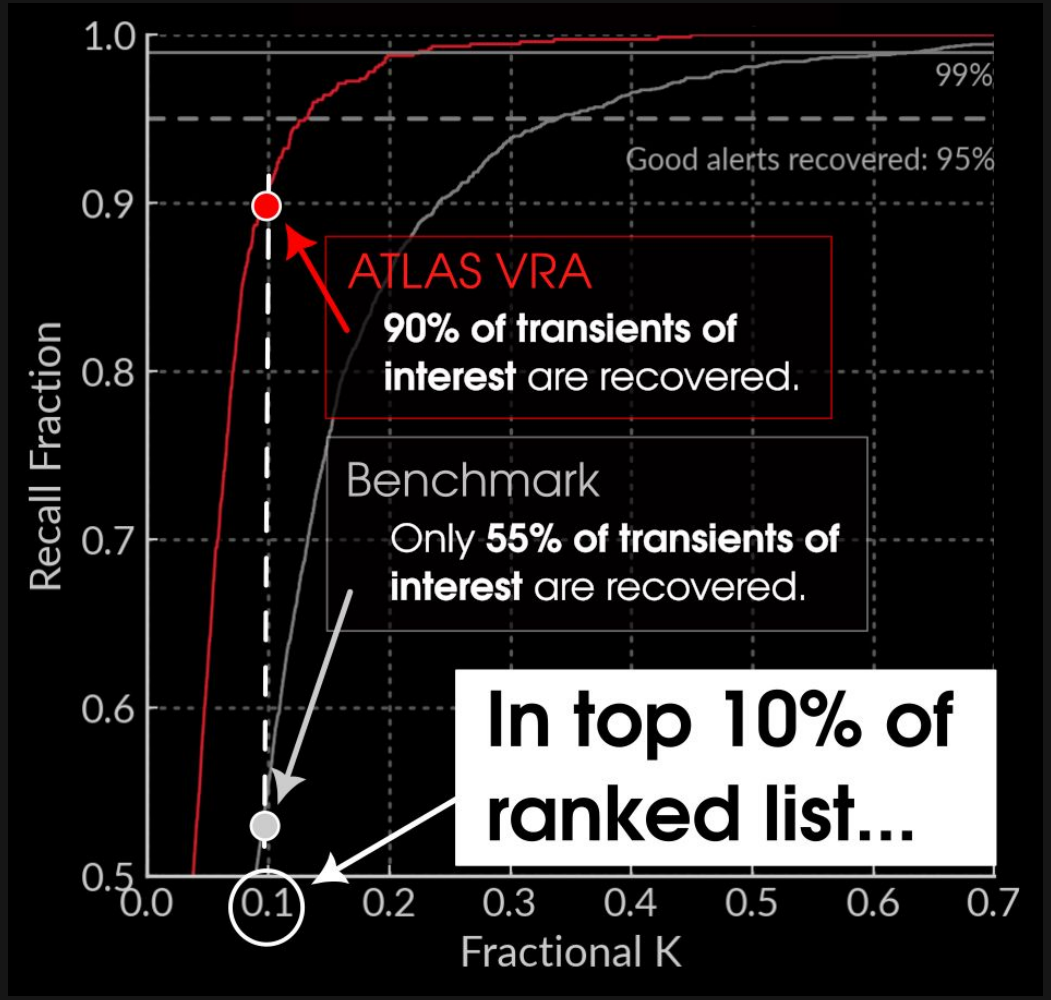
They just add extra layers of abstraction.

If you don’t need it DON’T USE IT.


SCORE SPACE [Validation]
Auto-Garbage
Garbage
PM
Galactic
Good
Galactic
Not Galactic
VRA
Not Real
Real
Galactic Score
Real Score
0.0
0.2
0.4
0.6
0.8
1.0
0
20

What metric? Benchmark?

Recall at Rank K



Key to success

Science driven design

The “intelligence” is not in the models

It’s in your design

Key to Scientific Legacy

Scientist centered design

What responsibilities are we willing to delegate to automation?

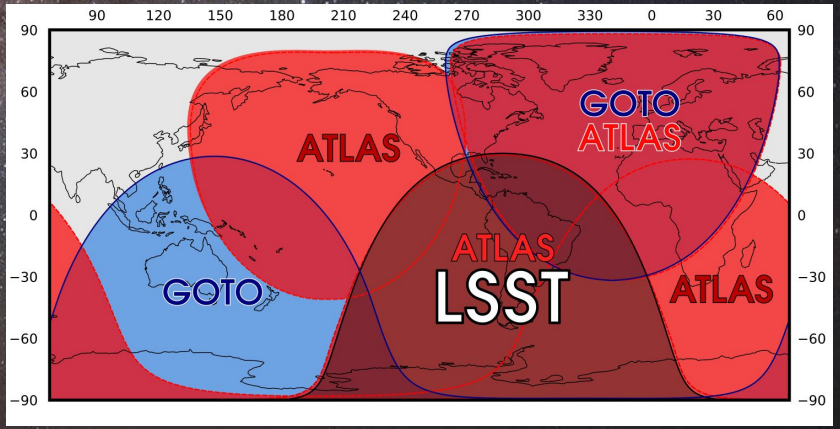
Increased complexity means increased *intellectual debt* !

atlas

Mag limit ~19.5

Cadence: 24h

LSST footprint fully covered!



THANK YOU!

hfstevance@gmail.com