Finding Early SNIa with the Fink broker

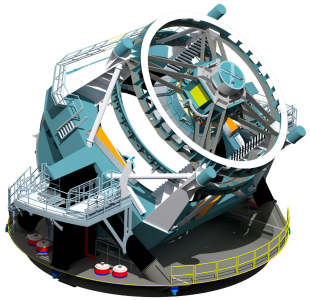
An extraordinary journey into the transient sky

4 April 2025

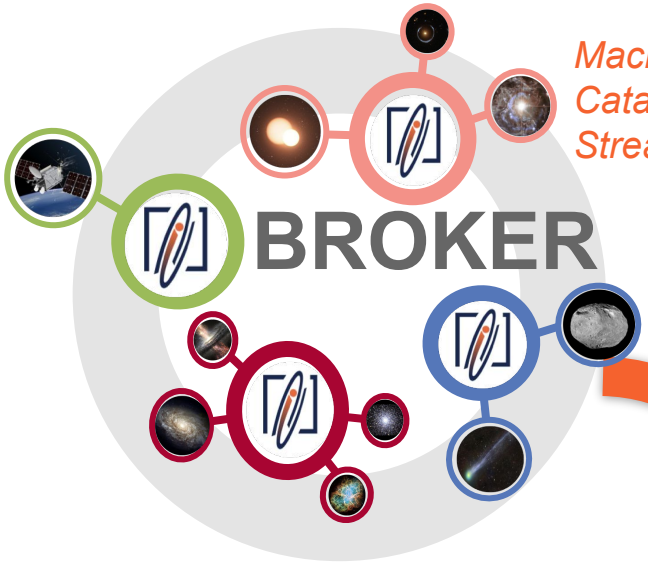
Emille Ishida, Anais Moller and Julien Peloton
on behalf of the Fink Team

The data path

every ~30 seconds down to mag ~24



10 million alerts per night…

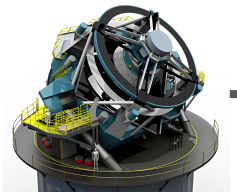


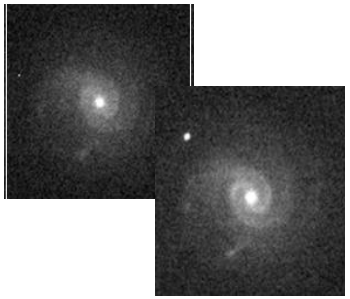
Machine learning
Catalog association
Streams join

*We would like the **interesting** ones ...*

How to classify alerts?

Broker world





Brokers

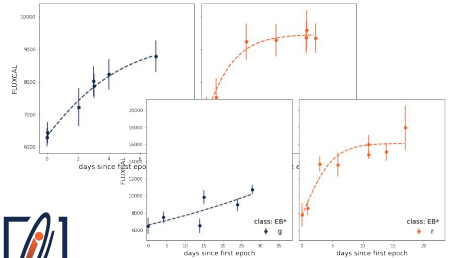
FINK

TDE

Early SNIa

Anomalies

Domain specialist world (this is you)



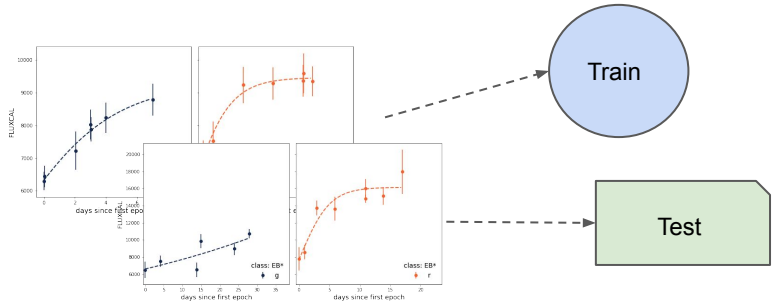
Taylored science module

f(alerts; ++) => class scores
Boolean

Case study: Early SN Ia classification

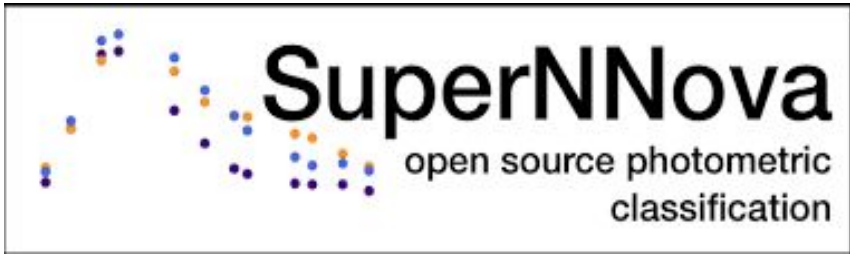
Problem 1: *labels are expensive, resources are limited*

Problem 2: *training (spectroscopically classified light curves) is not representative from test (purely photometric light curves)*



Goal: optimize classification results with small training

Strategy 1: transfer learning
Learn from simulations,
apply in real data



Moller and Boissiere, 2020, MNRAS

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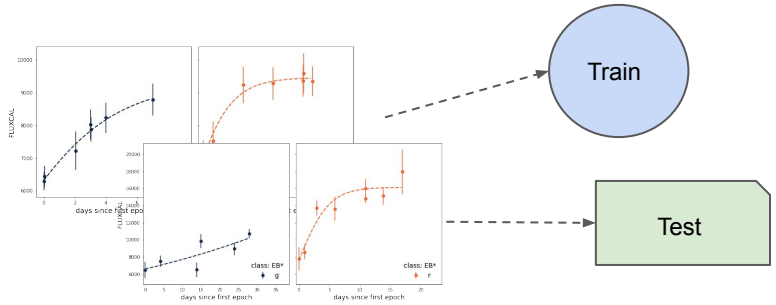
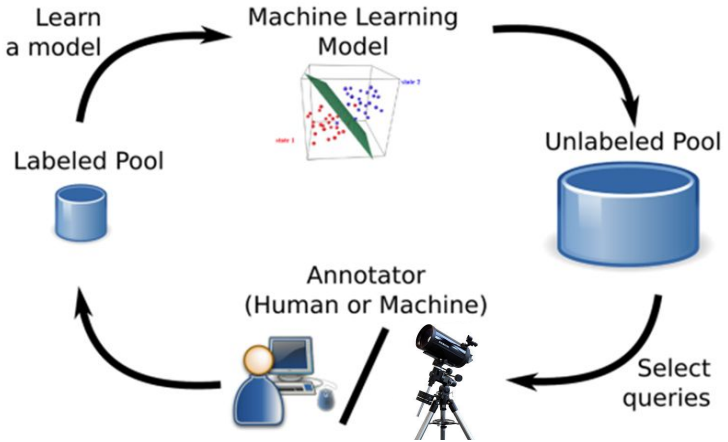


Goal: optimize classification results with small training

Strategy 2: optimize the construction of training samples

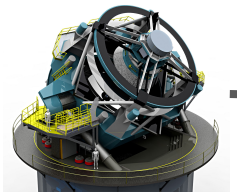


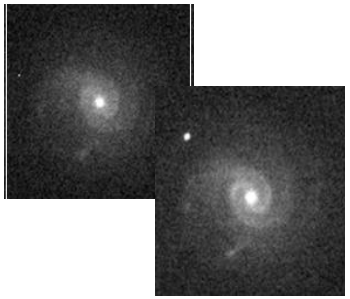
Leoni et al, 2022, Astronomy & Astrophysics, Volume 663, id.A13

Plot modified from Chowdhury et al., 2021, SPIE Medical Imaging

Case study: Early SN Ia classification

Broker world





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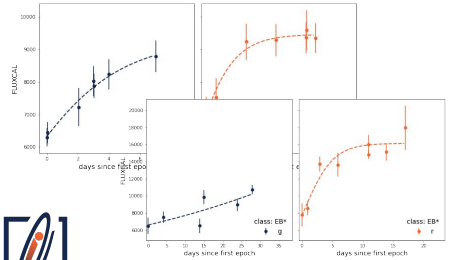


Early SNIa science module

f(alerts; model(SuperNNova open source photometric classification *)) => SNN score*

f(alerts; model(*)) => AL score*

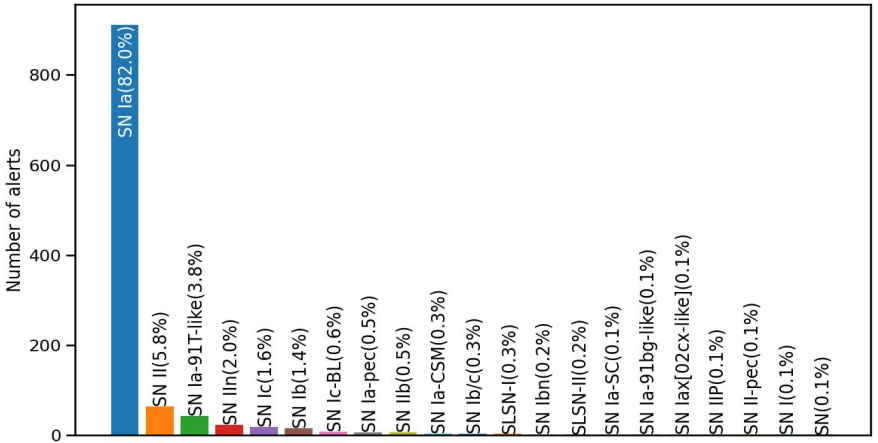
Early SNIa score

>0.5

Case study: Early SN Ia classification

- RF trained in 310 alerts chosen by AL
- Only rising candidates
- Agreement with SuperNNova
- Surviving candidates sent to TNS

- from Nov/2020 to Oct/20224:
  - 2633 candidates sent
  - 1182 classified (45%)
    - 966 confirmed SNIa (82%)



@FINK_EARLY_IA

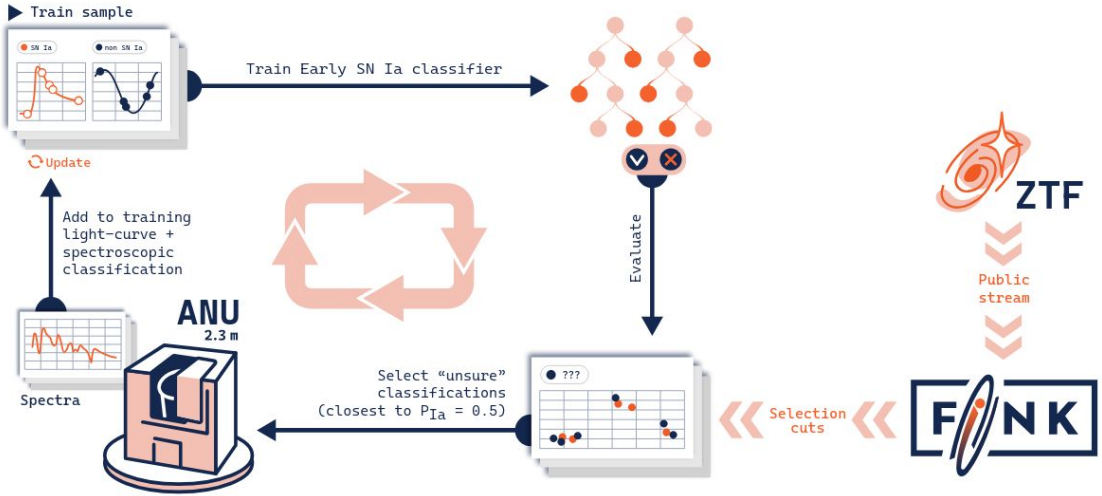
TRANSIENT NAME SERVER

Leoni et al, 2022, Astronomy & Astrophysics, Volume 663, id.A13

On-the-fly AL: Early SN Ia

Real-Time Active Learning for optimised spectroscopic follow-up: Enhancing early SN Ia classification with the Fink broker

A. Möller,[1,2] E. E. O. Ishida,[3] J. Peloton,[4] O. Vidal Velázquez,[1,2] J. Soon,[5] B. Martin,[5] M. Cluver,[1] M. Leoni,[4] and E. Taylor[1]



Moller et al, 2025, accepted to PASA, arXiv:astro-ph:2502.19555

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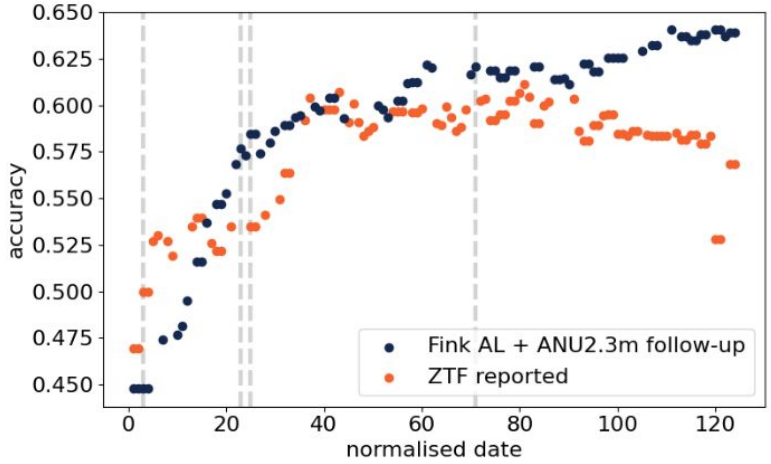
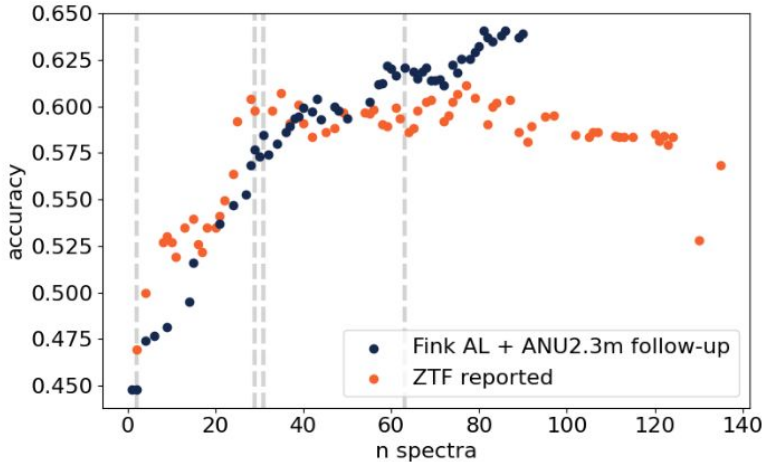




ANU 2.3m IFU for spectroscopic follow-up + extra spectra by DEBASS and ePESSTO+

Moller et al, 2025, accepted to PASA, arXiv:astro-ph:2502.19555

Target follow-up

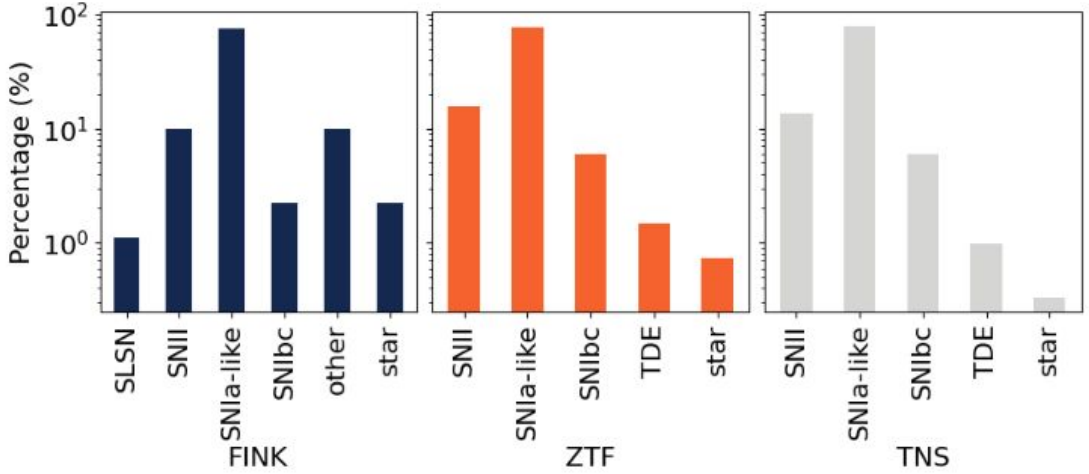


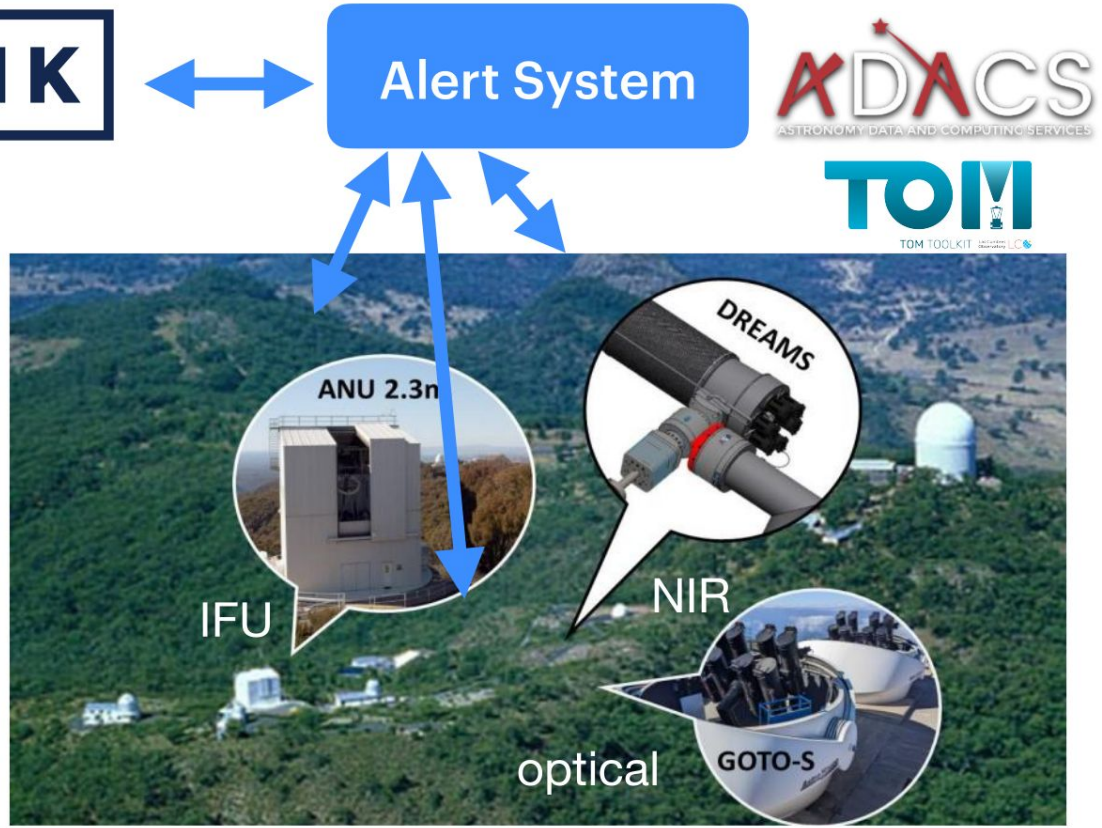
Figure 4. Spectroscopic classes for follow-up candidates in the FINK AL loop. We show from left to right panels FINK, ZTF and all TNS spectroscopic classifications. The percentage of SN families is similar to all strategies except for SLSN and other non-SN types of transients characterised by FINK.

Moller et al, 2025, accepted to PASA, arXiv:astro-ph:2502.19555

For Rubin

Robotic network
@ Siding Spring Observatory

Australia



Take home message

- Pool-based AL is only 1 possible strategy, there are others
- The output of all science modules are publicly available
- For Rubin, ideally the entire loop should be automatized
- This strategy can be applied for other **well-defined classes**
- It can be adapted for less well-known classes too …

Personalized ML ⇒ conversations

[Fink Collaboration meeting 2024]

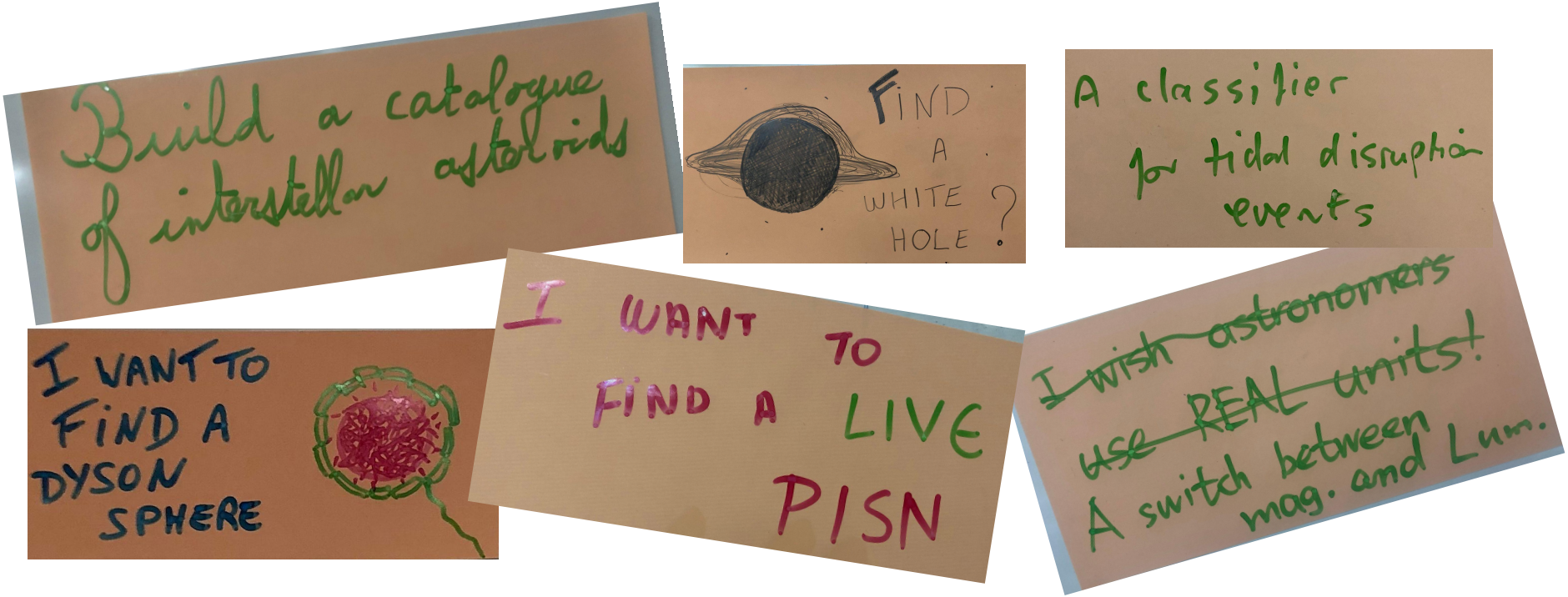
[ozFink meeting 2023]

[Fink hackathon 2022]

[Fink-Brazil Workshop 2024]

[Fink collaboration meeting 2022]

#FinkDreamShots



From OzFink 2023 - Melbourne, Australia - https://www.ozgrav.org/ozfink-workshop-2023.html

What do you want to see?

How to start a conversation?

1. Make a wish list of the type of light curve you would like to see
2. Contact the Fink team to discuss the feasibility of your proposal
3. Choose a data delivery method: kafka stream, bots, science portal, etc.
4. Inspect candidates, and return to step 2 until you are happy with the proposed candidates
5. Receive the data and perform your analysis!

Moller, Ishida et al., 2025

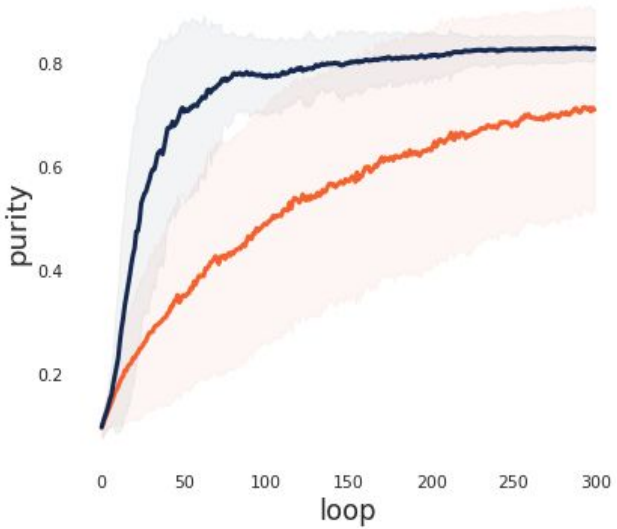
Table 3. FINK targets in the AL loop with types acquired with the ANU 2.3m spectra. Featureless and other indicate spectra which have no features consistent with a SN.

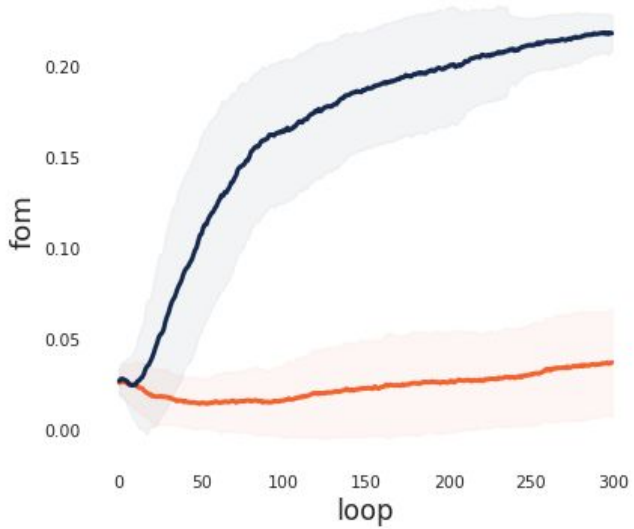
type	number
II	8
IIb	1
Ia	62
Ia-91T-like	2
Ia-pec	2
Iax[02cx-like]	1
Ibn	1
Ic-BL	1
SLSN	1
featureless	2
microlensing	2
other	5
star	2

Model trained on ZTF alerts

Results <u>after 300 loops</u>:

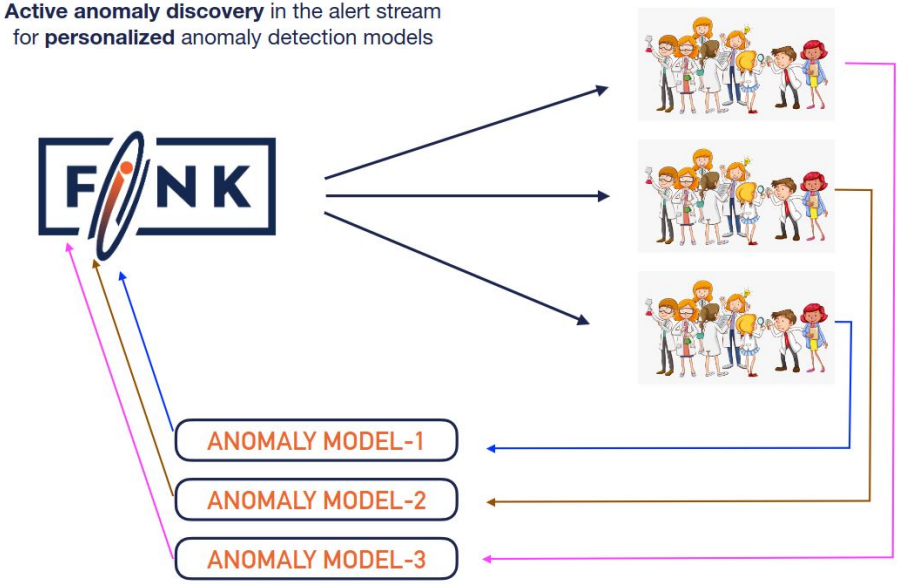
Training: 310 alerts
Testing: > 52 000 alerts





*Leoni, **Ishida** et al, 2022, Astronomy & Astrophysics, Volume 663, id.A13*

Fink Anomaly Detection module



Developed by T. Pshenichniy, M. Kornilov, M. Pruzhinskaya (MSU), I. Ippolitov (Industry)

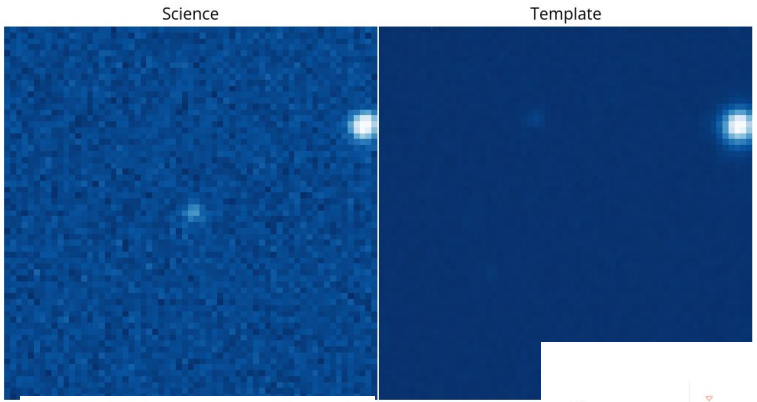
Algorithm from Das, S., et al., 2017, in DEA'17, KDD workshop, arXiv:cs.LG/1708.09441
Implementation by the SNAD team, via coniferest package

Fink services

- Live streams (Kafka streams): fink-client
  - *Whatfor? Live inspection, Follow-up*
  - Personalisable filters to select objects/parameters of interest
  - Data received “live” (+processing delays)
- Science Portal (dash-based) & REST API: https://fink-portal.org
  - *Whatfor? Visual inspection, small queries, daily monitoring*
  - All data processed remains accessible
- Data Transfer service: fink-client, post, link
  - *Whatfor? Bulk download, complex queries, ML/DL training, exotic analyses*
- TOM module
  - *Whatfor? Follow-up*
  - https://github.com/TOMToolkit/tom_fink

Case study: Hostless transients

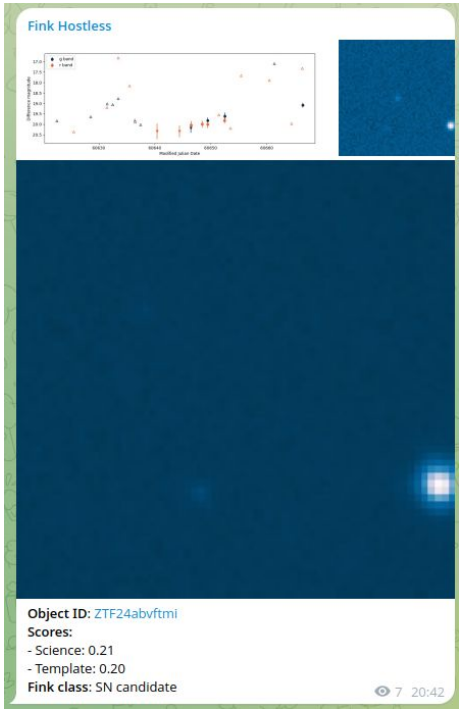
ELEPHANT: ExtragaLactic alErt Pipeline for Hostless AstroNomical Transients



ZTF24abvftmi

https://fink-portal.org/ZTF24abvftmi

Hostless SLSN which appear in the middle of holidays …



Priscila Pessi et al., 2024, Astronomy & Astrophysics, Volume 691, A181