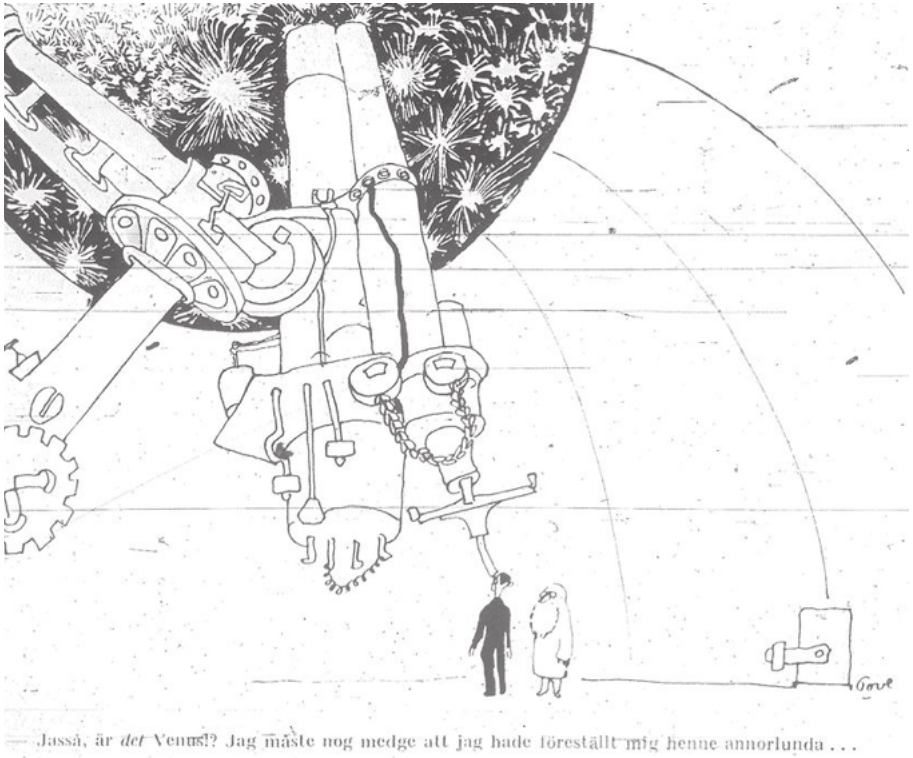


AMPEL

Analysis Engine 4 VRO

Jakob Nordin
Valery Brinnel, Jakob van Santen …
Humboldt University of Berlin

AMPEL

Analysis and workflow framework for high throughput time-domain astronomy.

Realizes code-to-data in astronomy.
https://github.com/AmpelAstro

One of the endpoints for the VRO alert stream.

Intro: AMPEL

- Designed as an Analysis Engine for time-domain data
- Open source python package: https://github.com/AmpelProject
- Executes modular science workflows while ensuring provenance and reproducibility
  - run locally …
  - … or at scale at computer center
- A broker when applied to real-time data!

Intro: Vera C. Rubin Observatory

- **Exciting times!**
- **Now running in “pre-survey” mode**
- **Will be years until full efficiency:**
  - ***Real Bogus***
  - ***Catalogs***
  - ***Photometric Classifiers***
  - ***Alert Filters***
- **Think long-term: What real-time science programs should run in five years?**

I - How to get data today

I - How

- **AMPEL Kafka**
- Choose Topic
- Parse Reports

```
from hop import Stream
from hop.io import StartPosition
from AmpelReport import AmpelTransientReport
```

[2]:

```
host = 'kafka://kafka.scimma.org/'
topic = 'ampel.lsst.reports-test'
```

[3]:

```
stream = Stream(start_at=StartPosition.EARLIEST, until_eos=True)
```

HOPSKOTCH

Hopskotch kafka streams:
https://www.scimma.org/hopskotch

I - How

- AMPEL Kafka
- **Choose Topic**
- Parse Reports

ampel.lsst.extragalactic-transients
Extragalactic transients with classification and/or distance.

ampel.lsst.extragalactic-infant
Young transients associated with nearby galaxies.

ampel.lsst.too-transients
Transients associated with VRO ToO/MM visits.

I - How

- AMPEL Kafka
- **Choose Topic**
- Parse Reports

To be extended…

ampel.lsst.tde

Core transients with TDE compatible lightcurves.

ampel.lsst.glsne

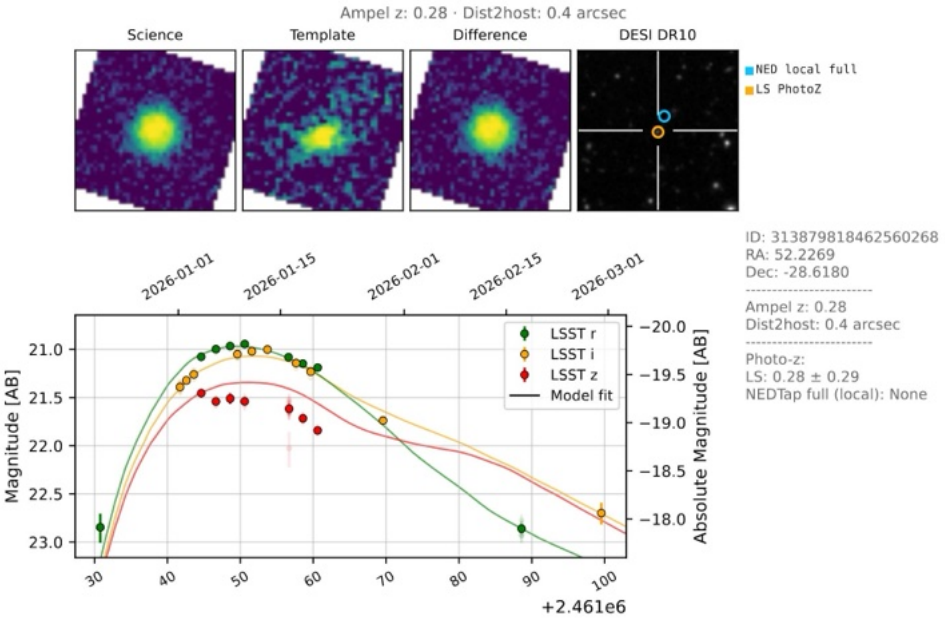
Transients compatible with gravitationally lensed transients.

ampel.lsst.your-special-topic

Build your own channel - can be turned into dedicated kafka topic.

I - How

- AMPEL Kafka
- Choose Topic
- **Parse Reports**



- Use AmpelAccess
  https://github.com/AmpelAstro/Ampel-Access

- Automate `ReportResponse`!!
  - Run locally with your tweaked filter
  - Store alerts
  - Automatic process: Immediate Slack notice, TOM referral or follow-up request.
  - Upload for vizualisation (eg. Skyportal)

II - AMPEL Report Content

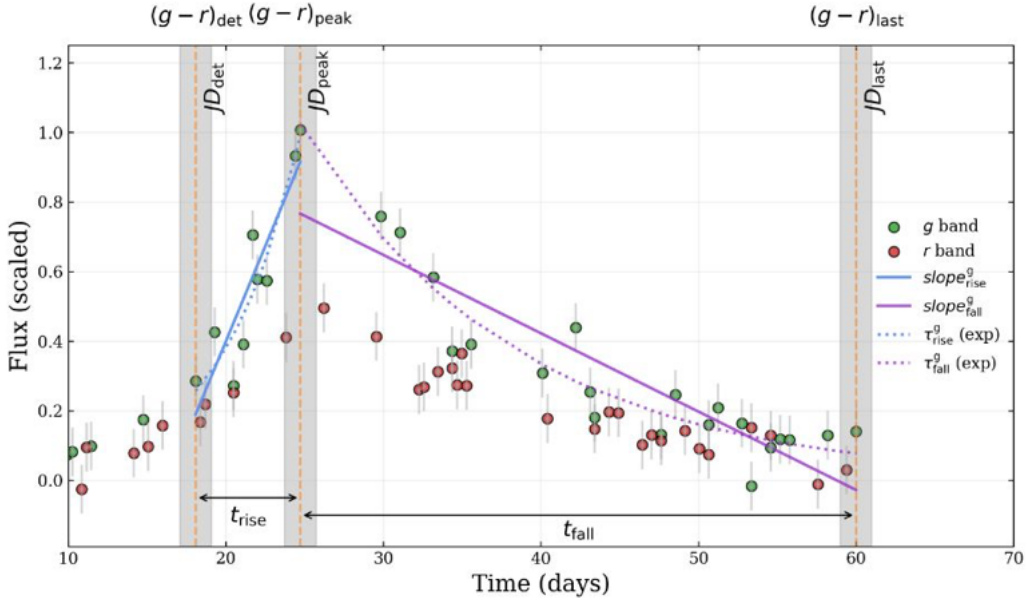
II - Photometric Classification

High quality classifiers - verified performance

RiseDecline:

Optimized for few detections

Miranda et al(https://arxiv.org/abs/2208.06534)



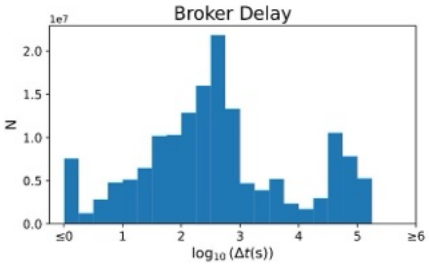
II - Photometric Classification

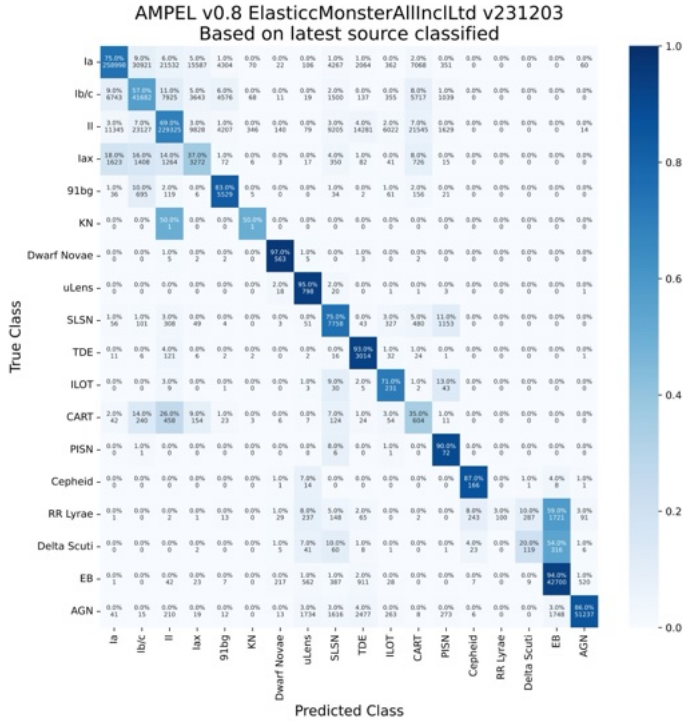
High quality classifiers - verified performance

Blinded verification:

ELAsTiCC & Mallorn

Nordin et al (A&A, 698, A13 (2025))





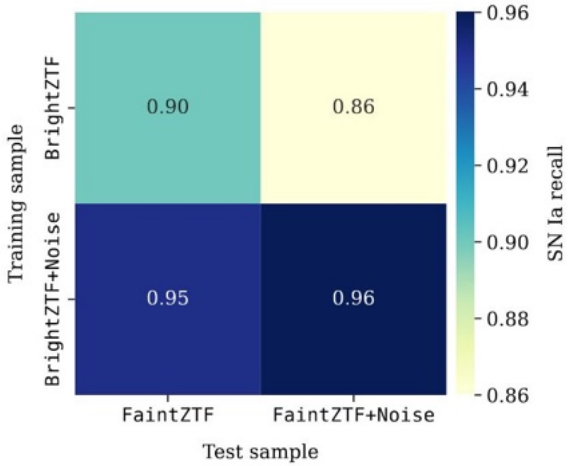
II - Photometric Classification

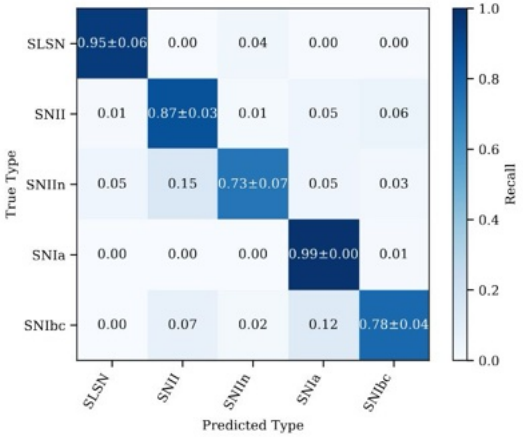
High quality classifiers - verified performance

noiZTF:

Verified on real data

Townsend et al(https://arxiv.org/abs/2602.13036)



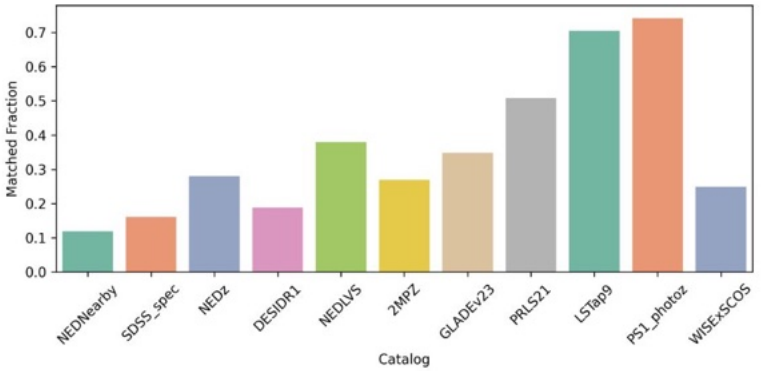


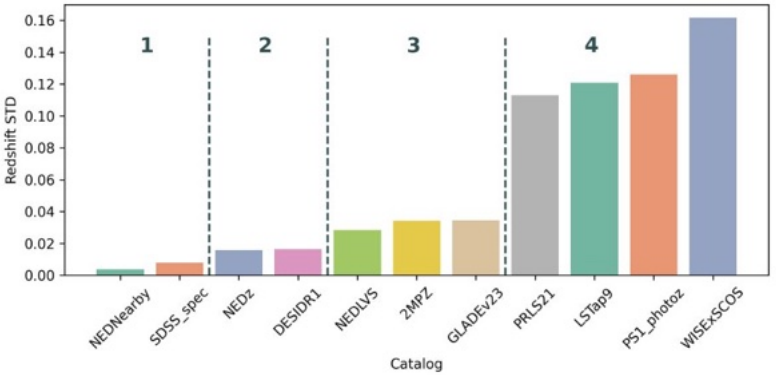
II - Catalog / Distance

Aggregate Catalog Information

- **Ampel z**
- **Ampel z Group**
- **Catalog Distance**

Photometric Distance information propagets through selection - filter based on Ampel z Group.

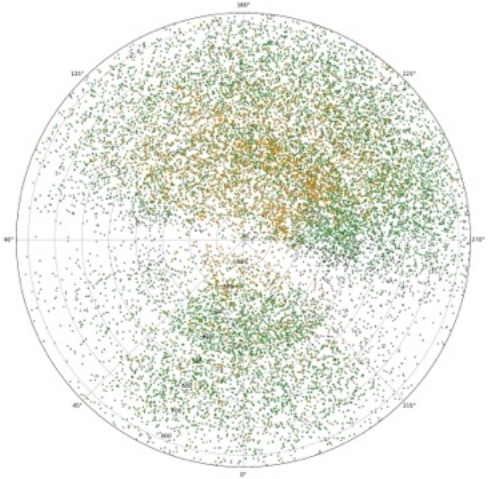




III - Why an Analysis Engine

III - Why

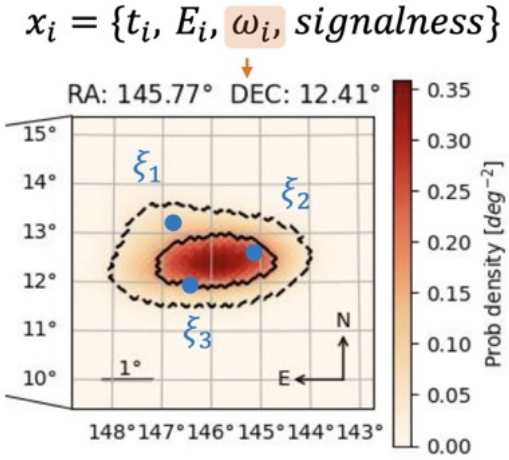
Guided by VRO Science



SN Ia Selection Function

Large, statistical analysis:

- Reproduce analysis after 3yrs
- Improve grandfather pipeline
- Rerun with new method

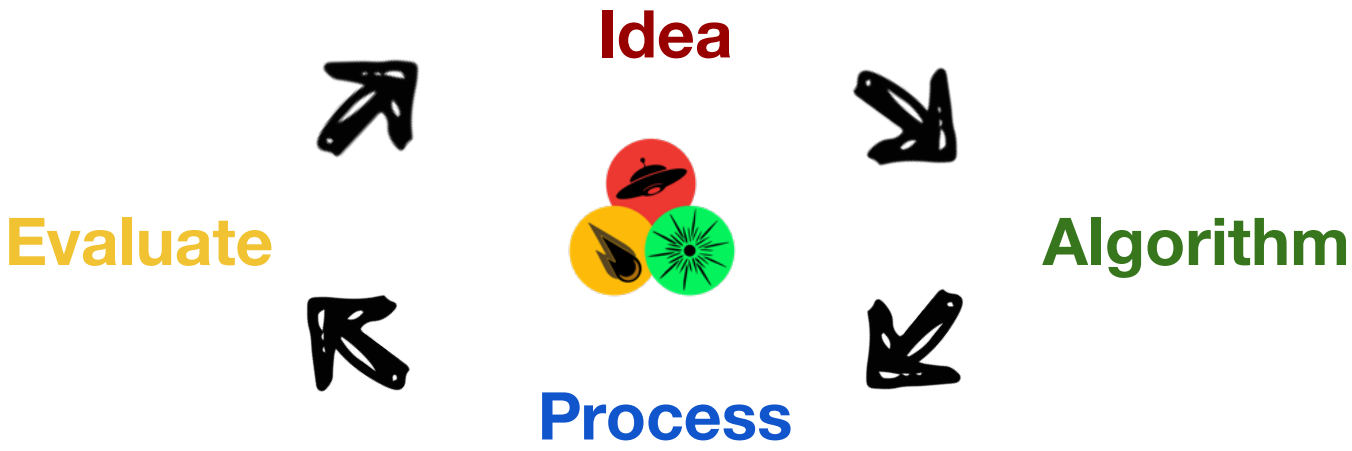


MM Associations

Telescope Networks

III - Why

AMPEL runs the Analysis Cycle

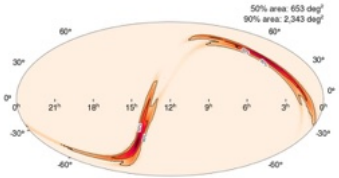


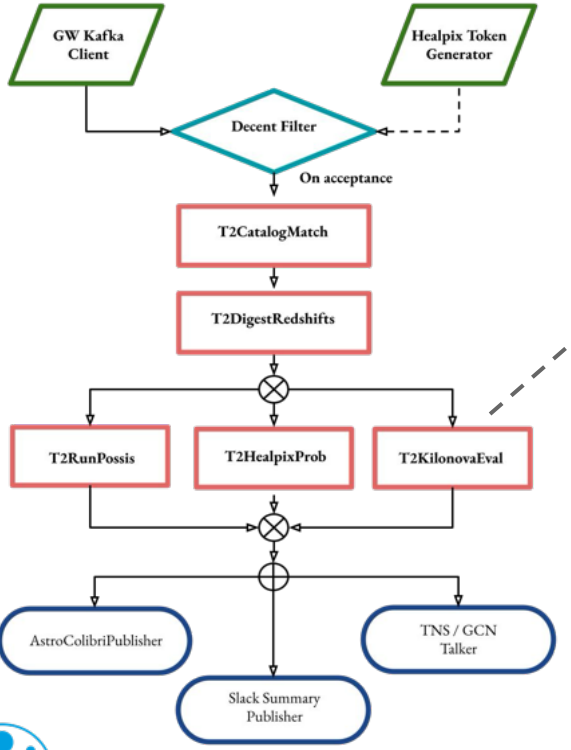
1. Simulation 2. Archive 3. Real-time ⟷ Front-end / Follow-up

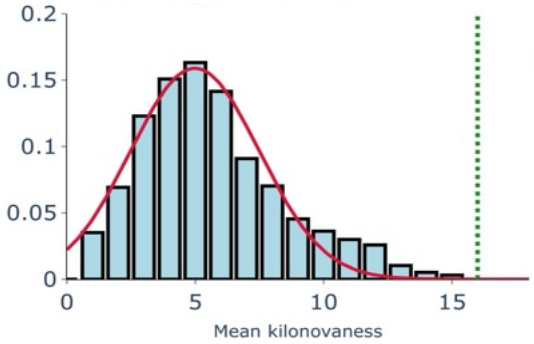
III - Why

Development Process

1. **Design**
   - Install local environment
   - Design workflow
   - Identify existing units







2. **Develop**
   - Create interface to science specific algorithm(s).
   - Test ...

3. **Run**
   - Scale at computer center
   - Public live instance @ DESY
   - Publish code for others

III - Why

Development Process

1. **Design**
   - Install local environment
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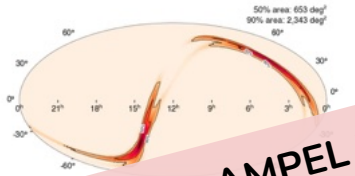

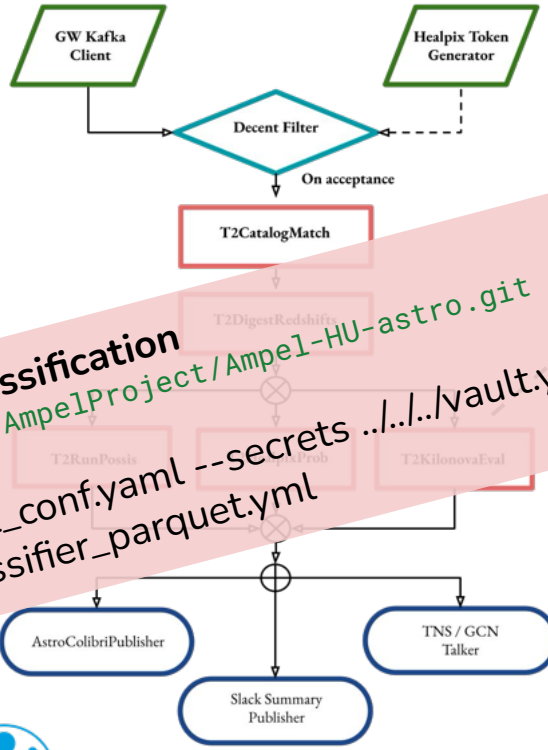

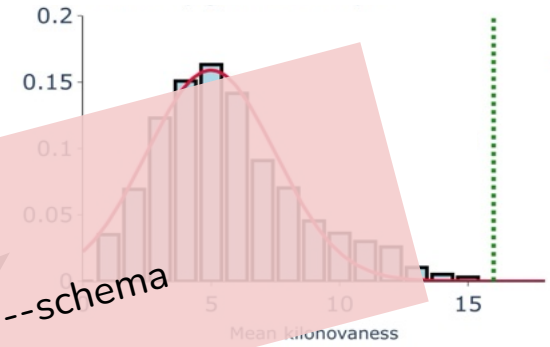

Reproduce AMPEL VRO Classification

```
git clone https://github.com/AmpelProject/Ampel-HU-astro.git
...
ampel job --config ../ampel_conf.yaml --secrets ../../../vault.yaml --schema
vroprep_extragalactic_classifier_parquet.yml
```

2. **Develop**
   - Create interface to science specific algorithm(s).
   - Test ...

3. **Run**
   - Scale to computer center
   - Public live instance @ DESY
   - Publish code for others

DESY.

Conclusions

Getting started in the VRO era! Journey ahead of us …

1. **Curated Kafka streams: incorporate into your science**
2. **Verified photometric classifications**
3. **For full statistical power: Run AMPEL yourself**

Further information:

- **Info page: https://ampelastro.github.io/**
- **Access Kafka alerts: https://github.com/AmpelAstro/Ampel-Access**
- **Install AMPEL: https://github.com/AmpelAstro/Ampel-HU-astro**
- **Try Hopskotch: https://www.scimma.org/hopskotch**

Or contact me directly! jnordin at physik.hu-berlin.de