



AMPEL

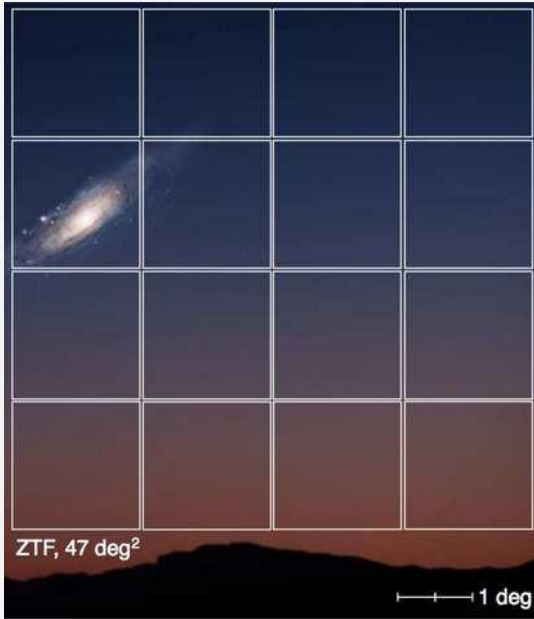
Alert Management, Photometry and Evaluation of Lightcurves

Jakob Nordin, HU Berlin
with Vallery Brinnel, Jakob van Santen, Matteo Giomi, Uli Feindt ...
SCIOPS 2019



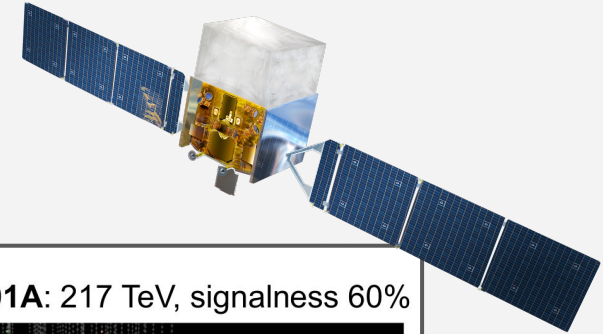
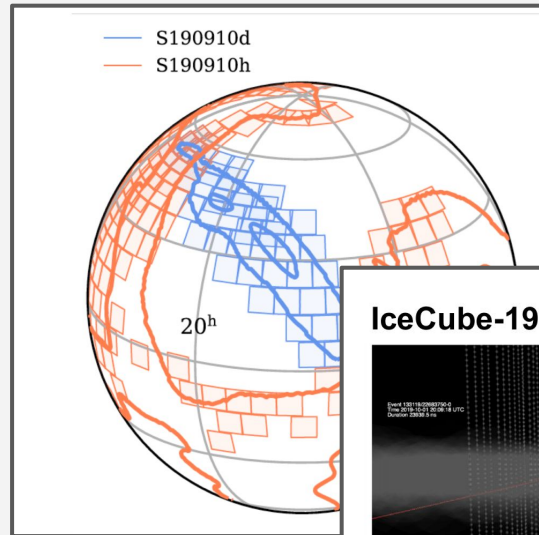
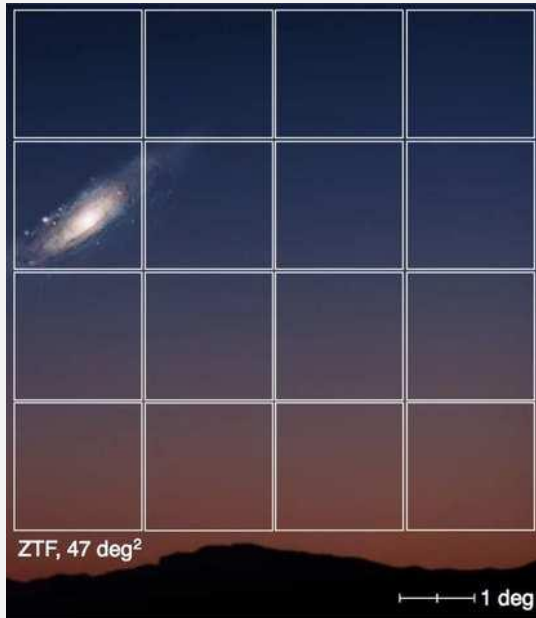
“Future” happened a ~year ago...

Transient detection

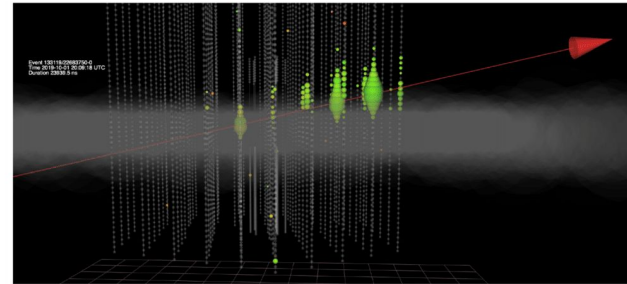


“Future” happened a ~year ago...

Transient detection

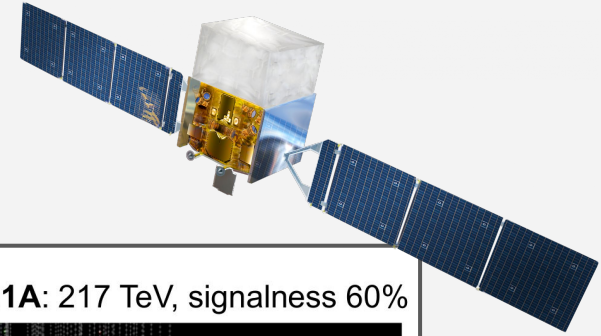
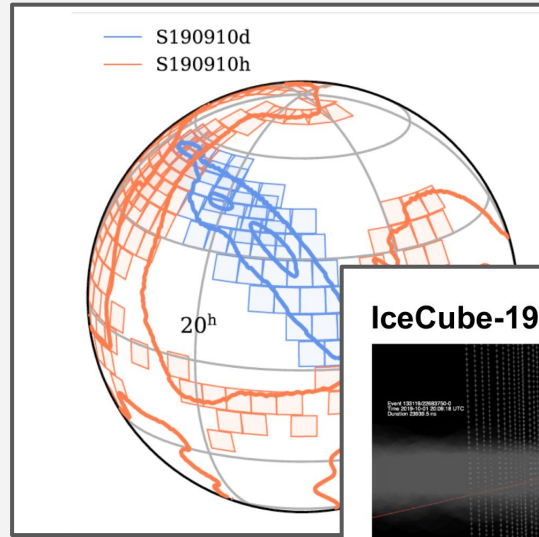
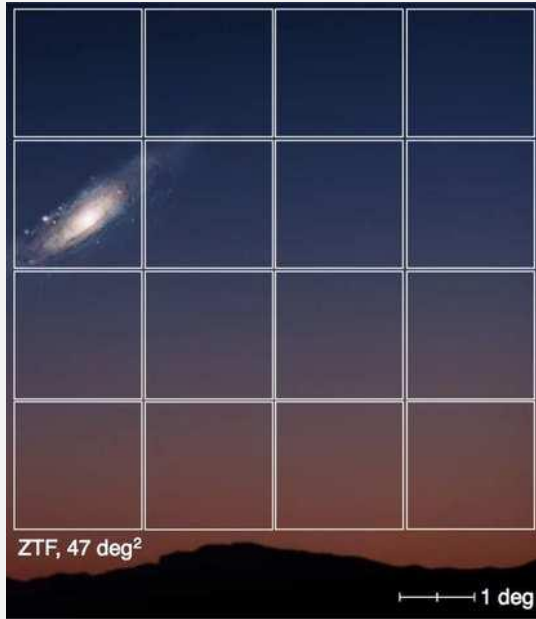


IceCube-191001A: 217 TeV, signalness 60%

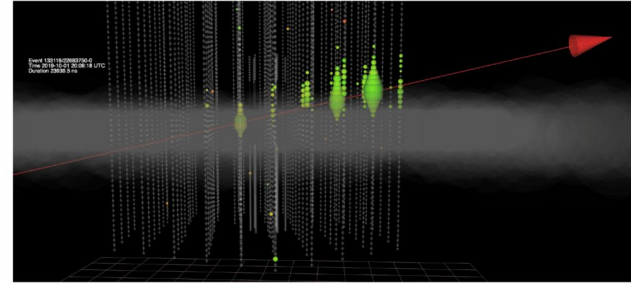


“Future” happened a ~year ago...

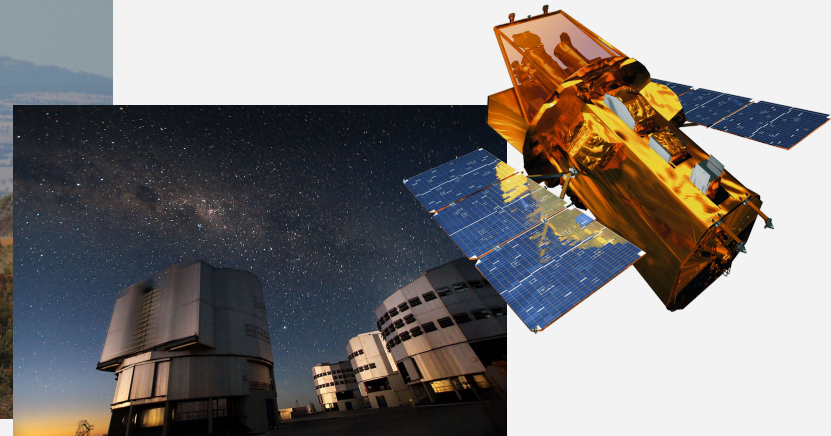
Transient detection



IceCube-191001A: 217 TeV, signalness 60%



Robotic follow-up





AMPEL is:
a public software
framework for the
selection, analysis
and reaction to MM
transient data
("broker").



Bad transient

Take a closer look

Do something... now!

Ampel live

1. Optical GW counterpart candidates
2. Tidal Disruption Event search algorithms
3. Automatic publication of extragalactic ZTF transients
4. Robotic detection, selection and follow-up of SNe
5. Combined likelihood from optical and neutrino data.
6. Complete transient samples (RCF)

Thread
ampel_mm_bot

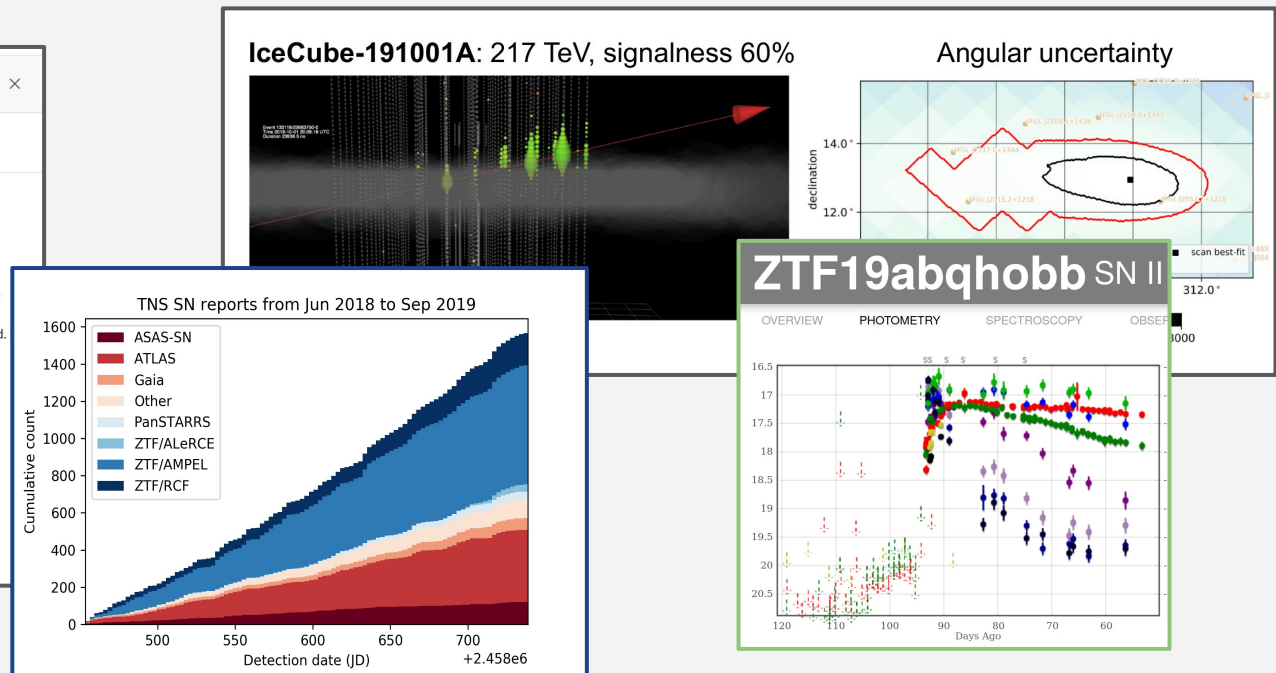
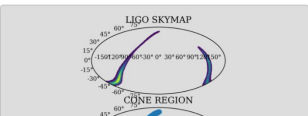
Jakob Nordin Yesterday at 9:29 PM
👉 S191109d
10 replies

ampel_mm_bot APP 12 hours ago
Hi @Jakob Nordin! You are interested in Ampel multi-messenger stuff, right? Let me get right on that for you.

ampel_mm_bot APP 12 hours ago
You are interested in LIGO event S191109d. No revision number has been specified. I will just take the most recent revision for this event. The Skymap will be scanned up to 95.0% of the probability. No time range has been specified. will scan from merger time to now.

ampel_mm_bot APP 12 hours ago
Scanning method: time
Effective sky number: 2.7018813334871083

ampel_mm_bot APP 12 hours ago
LIGO skymap



Ampel live

[[Previous](#) | [Next](#) | [ADS](#)]

Candidate Counterparts to IceCube-191001A with ZTF

ATel #13160; **Robert Stein (DESY), Anna Franckowiak (DESY), Jannis Necker (DESY), Suvi Gezari (UMd), Sjoert van Velzen (UMd/NYU)**
on 2 Oct 2019; 22:00 UT

Distributed as an Instant Email Notice Transients
Credential Certification: Anna Franckowiak (anna.franckowiak@desy.de)

Subjects: Radio, Optical, X-ray, Neutrinos, Supernovae, Transient, Tidal Disruption Event

Tweet

On behalf of the Zwicky Transient Facility (ZTF) and Global Relay of Observatories Watching Transients Happen (GROWTH) collaborations: We observed the localization region of the neutrino event IceCube-191001A (Stein et. al, GCN 25913) with the Palomar 48-inch telescope, equipped with the 47 square degree ZTF camera (Bellm et al. 2019, Graham et al. 2019). We started obtaining target-of-opportunity observations in the g-band and r-band beginning at 2019-10-02T03:32:47.200, approximately 7.4 hours after event time. Excluding chip gaps, we covered the entire reported localisation region of the neutrino. Each exposure was 300s with a typical depth of 21.0 mag. The images were processed in real-time through the ZTF reduction and image subtraction pipelines at IPAC to search for potential counterparts (Masci et al. 2019). AMPEL (Nordin et al. 2019) was used to search the alerts database for candidates. We reject stellar sources (Tachibana and Miller 2018) and moving objects, and apply machine learning algorithms to remove bogus subtractions (Mahabal et al. 2019). We are left with 10 high-significance transient candidates by our pipeline, and highlight four that are particularly interesting.

ZTF Name	IAU Name	RA (deg)	DEC (deg)	Filter	Mag	MagErr
ZTF19aapreis	AT2019dsg	314.2623825	+14.2045431	g	19.79	0.05
ZTF19abzkebx	AT2019qhl	320.5502682	+11.5600861	g	19.13	0.03
ZTF19acbpqfn	AT2019rsj	316.0854222	+12.9171434	g	21.00	0.14
ZTF19acbxbjq	AT2019rsk	318.6378536	+14.1469459	g	20.32	0.08
ZTF19aapreis is a Tidal Disruption Event approximately 150 days post peak,						

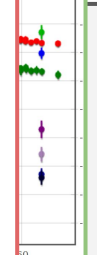
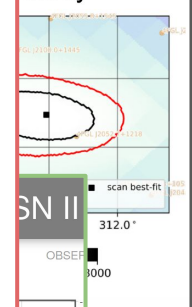
Detection date (JD) +2.458e6

Related

- 13160** Candidate Counterparts to IceCube-191001A with ZTF
- 13105** Mass-loss rate constraints from e-MERLIN observations of the Type Iax SN 2019muj
- 12960** Unambiguous radio detection of the tidal disruption event AT2019dsg with e-MERLIN
- 12870** Radio detection of the tidal disruption event AT2019azh
- 12825** NICER X-ray observations of the young tidal disruption flare candidate AT2019dsg
- 12798** A possible radio detection of the TDE candidate AT2019DSG by AMI-LA
- 12777** Swift discovers X-rays from the newly discovered tidal disruption flare candidate AT2019dsg
- 12752** ePESSTO+ classification of optical transients
- 12751** Swift Bulge Survey detections of the X-ray transients SAX J1750.8-2900 and IGR J17445-2747

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Days ago


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Thread
ampel_mm_bot


 **Jakob Nordin**
\$191109d

10 replies

 **ampel_mm_bot**
Hi @Jakob Nordin
messenger stuff

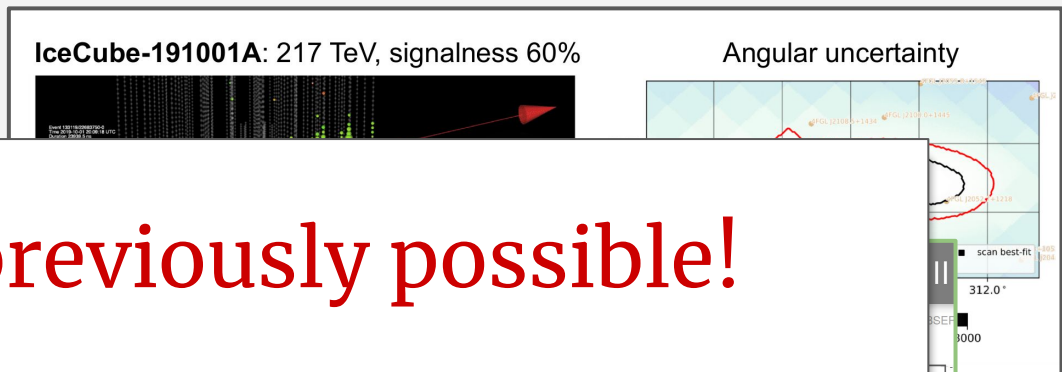
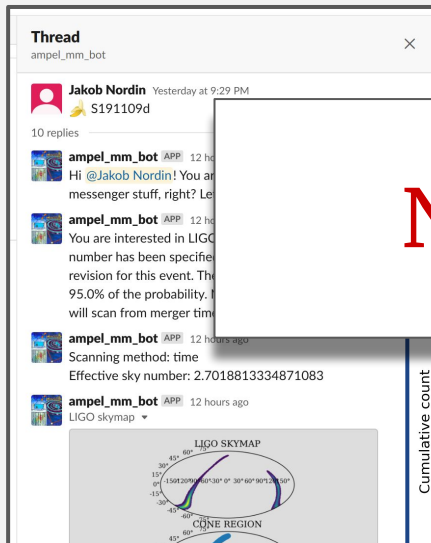
 **ampel_mm_bot**
You are interest
number has been
revision for this
95.0% of the pr
will scan from n

 **ampel_mm_bot**
Scanning metho
Effective sky nu

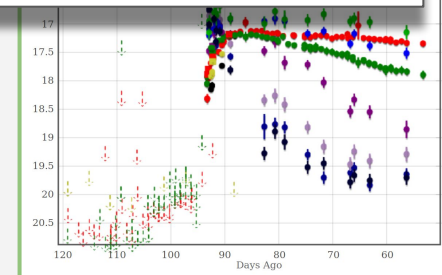
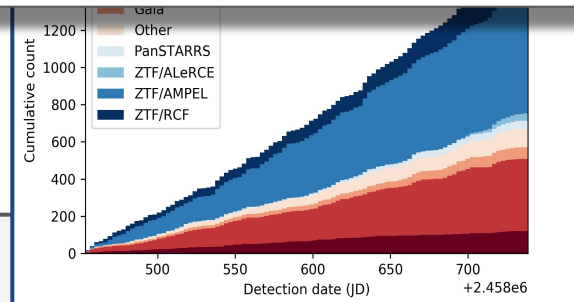
 **ampel_mm_bot**
LIGO skymap

Ampel live

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3. Automatic publication of extragalactic ZTF transients
4. Robotic detection, selection and follow-up of SNe
5. Combined likelihood from optical and neutrino data.
6. Complete transient samples (RCF)



Not previously possible!



Challenges

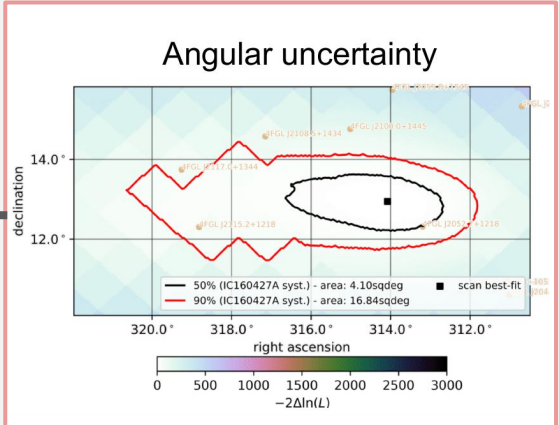
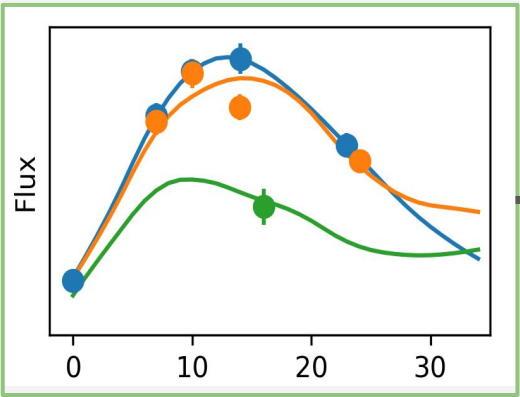
stream 1



ICECUBE
SOUTH POLE NEUTRINO OBSERVATORY

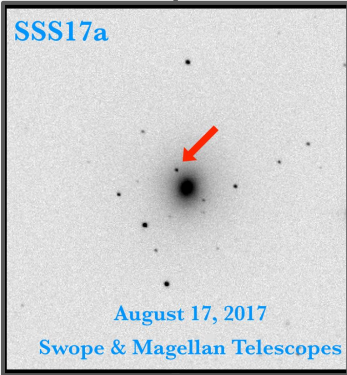
stream 2

analysis 1



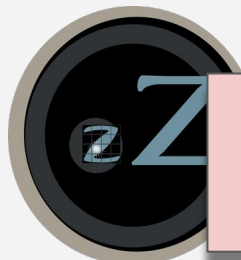
analysis 2

joint
analysis



reaction

stream 1



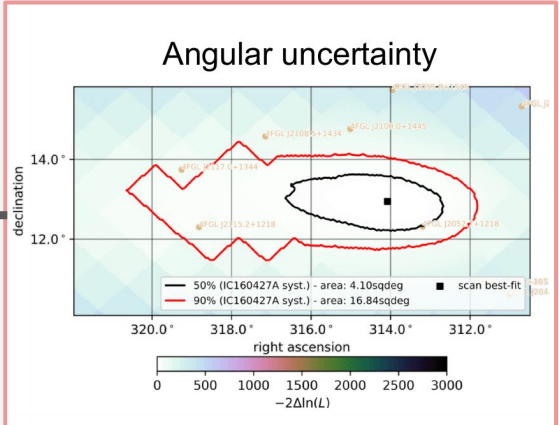
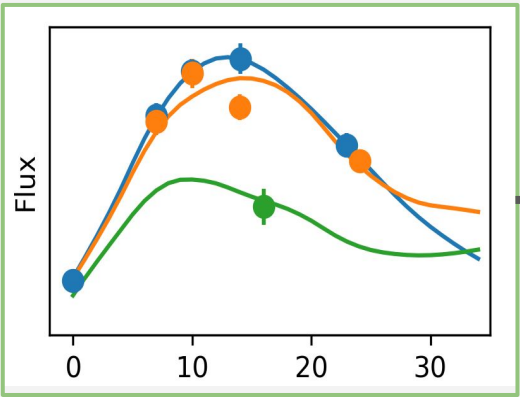
Access to streams



ICECUBE
SOUTH POLE NEUTRINO OBSERVATORY

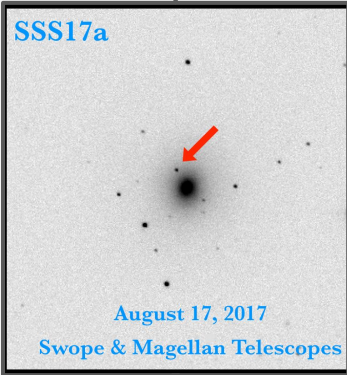
stream 2

analysis 1



analysis 2

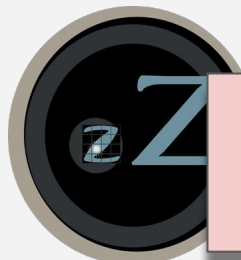
joint
analysis



reaction



stream 1



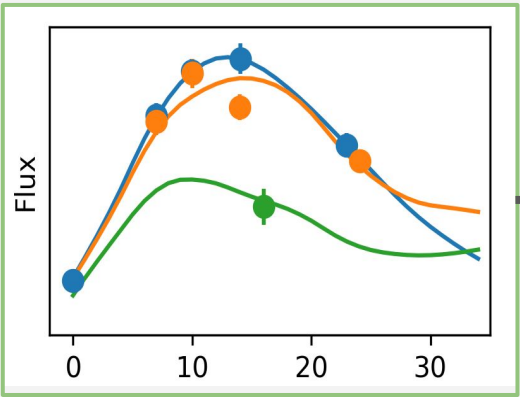
Access to streams



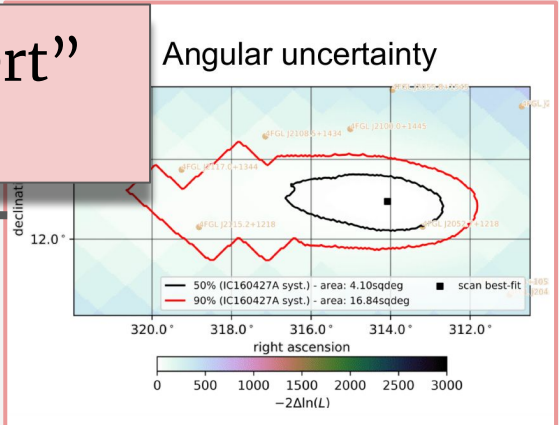
ICECUBE
SOUTH POLE NEUTRINO OBSERVATORY

stream 2

analysis 1

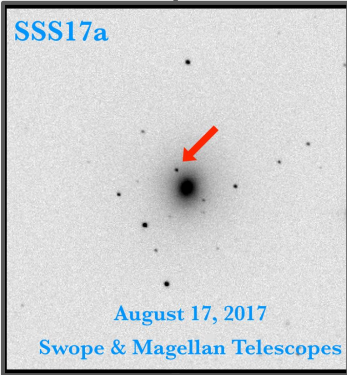


Hosting “expert” software



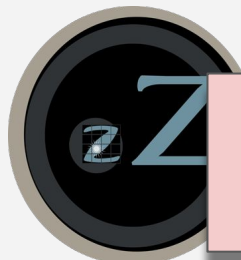
analysis 2

joint analysis



reaction

stream 1



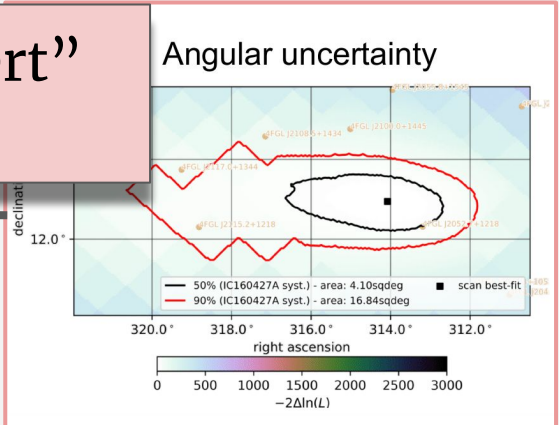
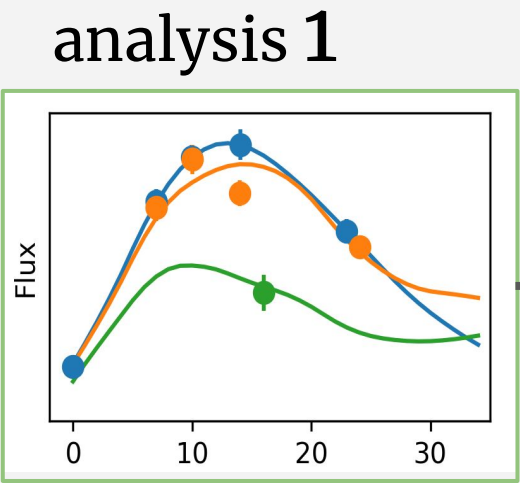
Access to streams



ICECUBE
SOUTH POLE NEUTRINO OBSERVATORY

stream 2

Hosting “expert” software



Input expectation

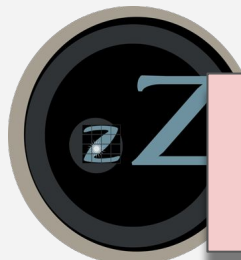
analysis 2

joint analysis



reaction

stream 1



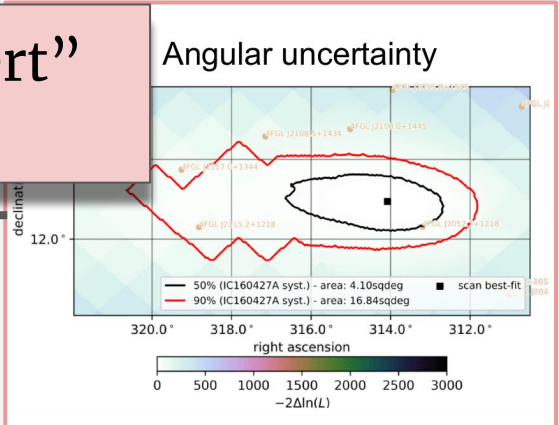
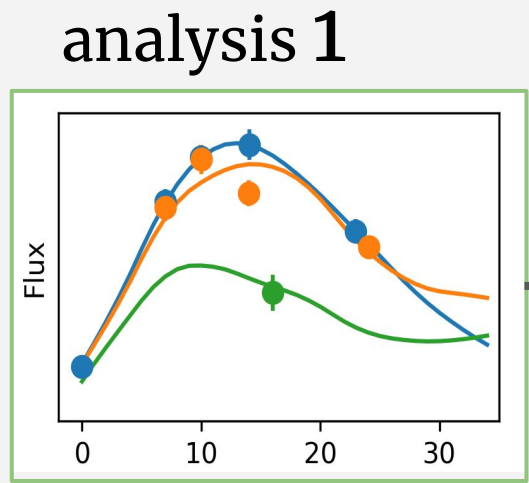
Access to streams



ICECUBE
SOUTH POLE NEUTRINO OBSERVATORY

stream 2

Hosting "expert" software



Input expectation

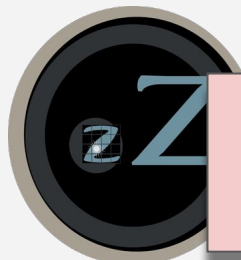
Chaining & scheduling

nt
analysis



reaction

stream 1



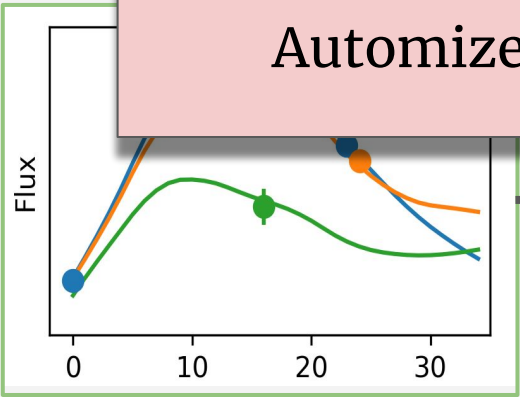
Access to streams



ICECUBE
SOUTH POLE NEUTRINO OBSERVATORY

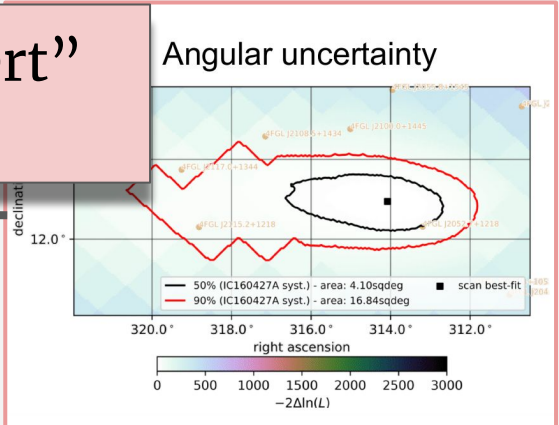
stream 2

analysis 1



Automized

Hosting "expert" software



Input expectation

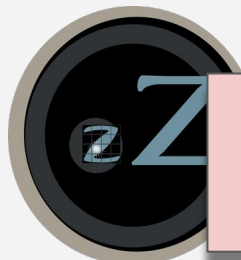
analysis 2

Chaining & scheduling



reaction

stream 1

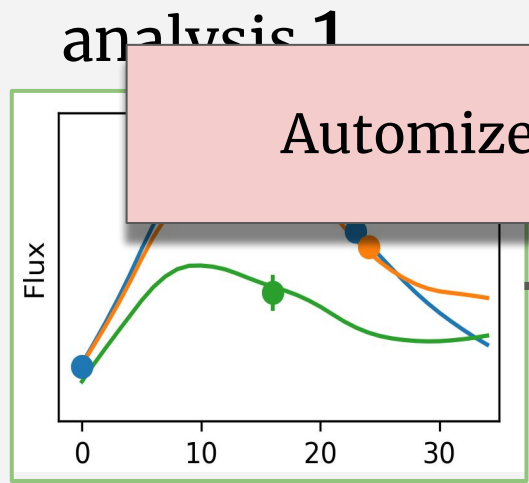


Access to streams



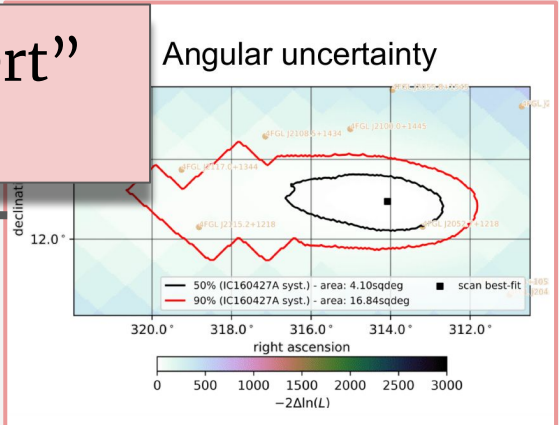
ICECUBE
SOUTH POLE NEUTRINO OBSERVATORY

stream 2



Automized

Hosting "expert" software

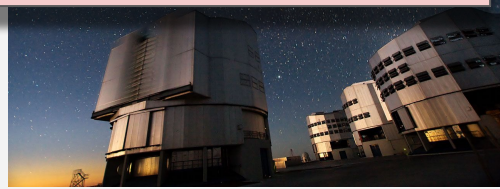


Input expectation

Chaining & scheduling

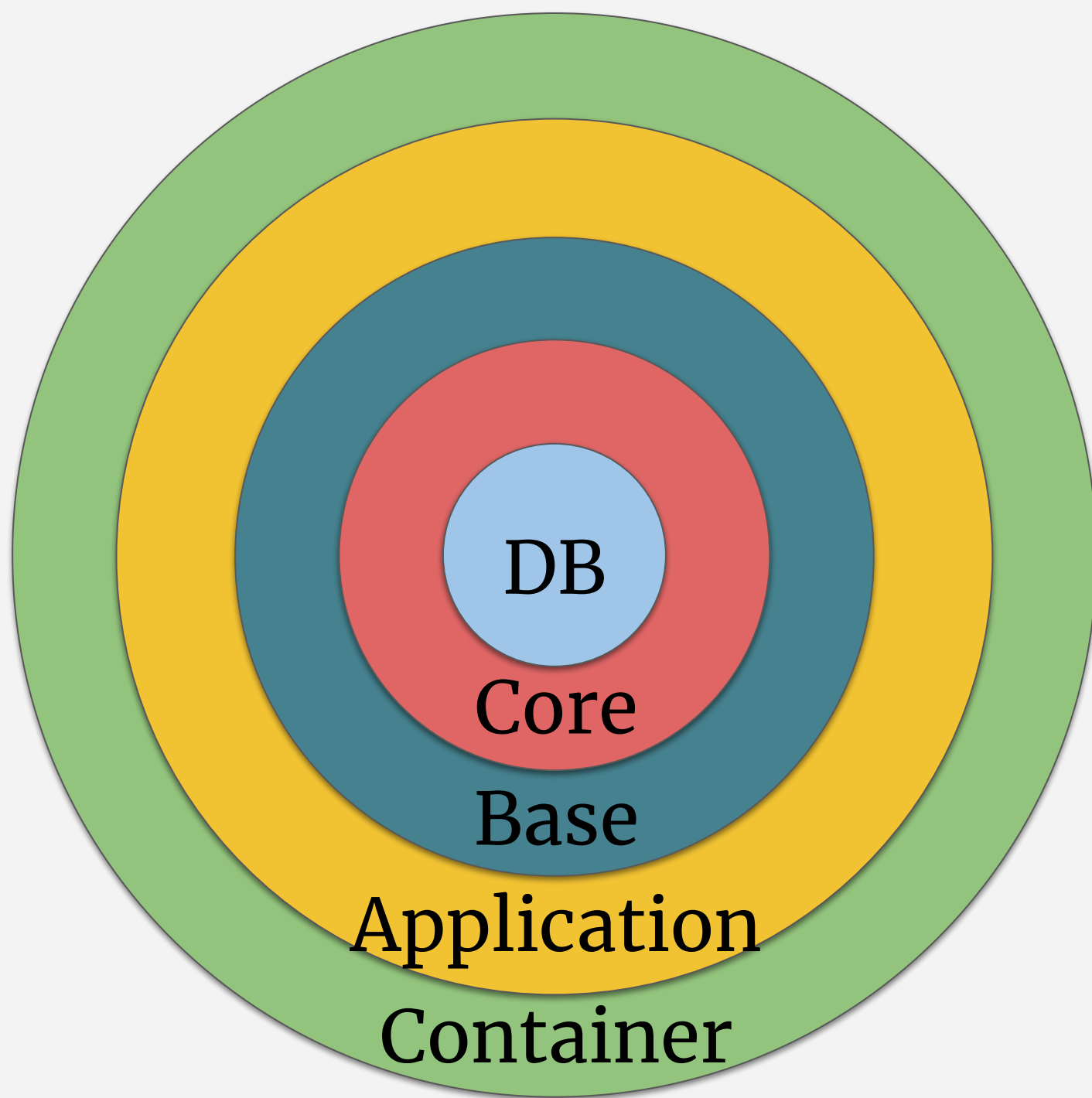


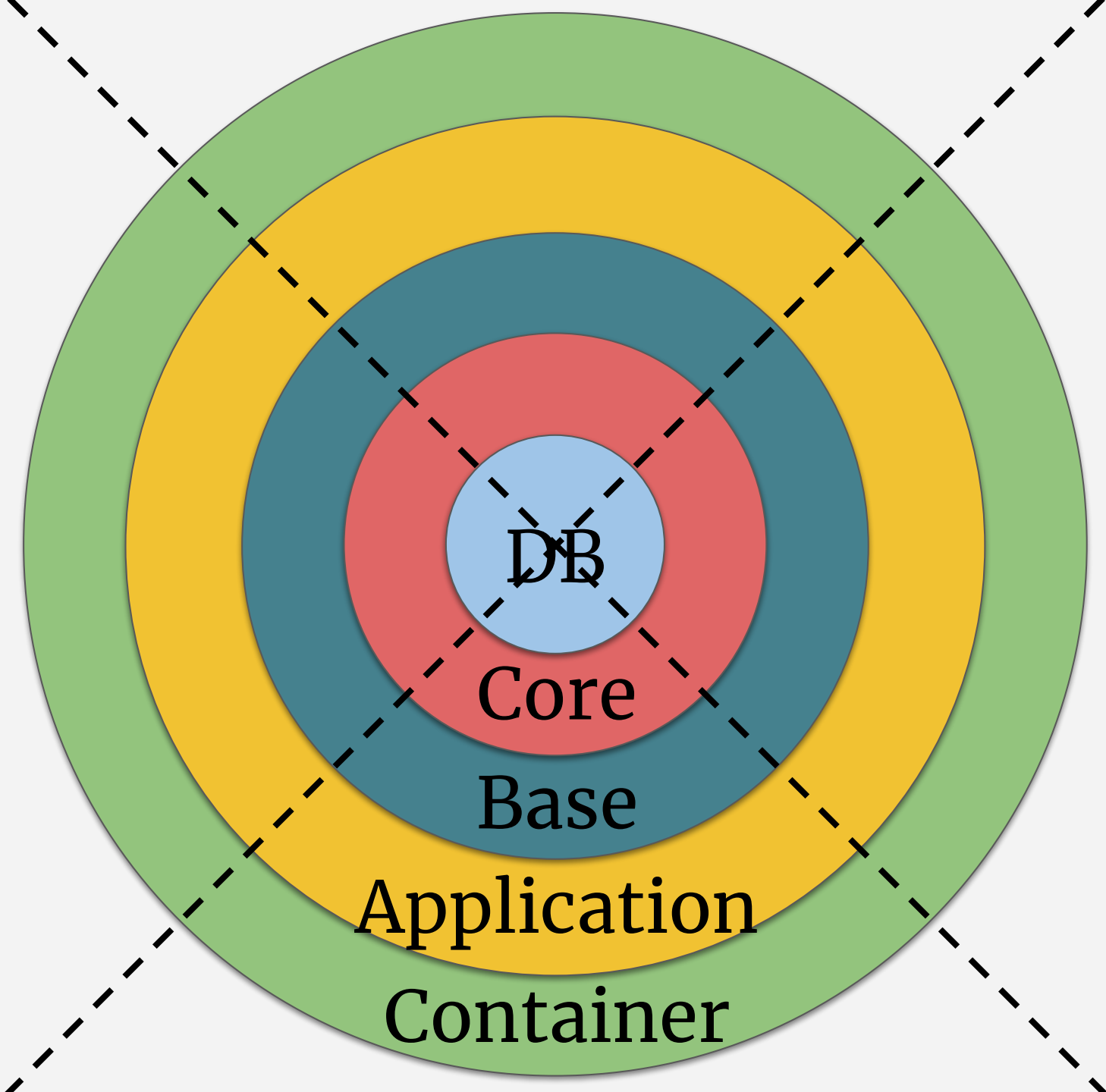
Reproducible



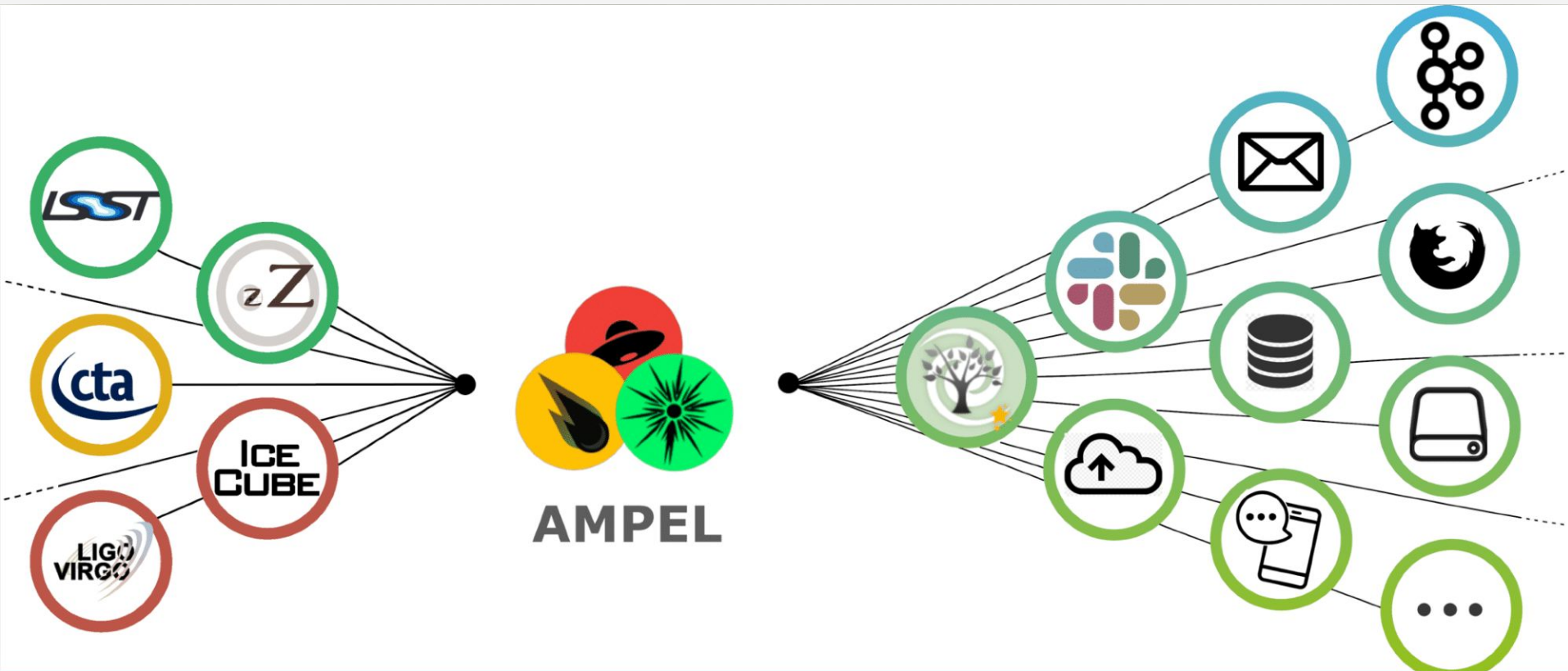
reaction

AMPEL





Execution layers

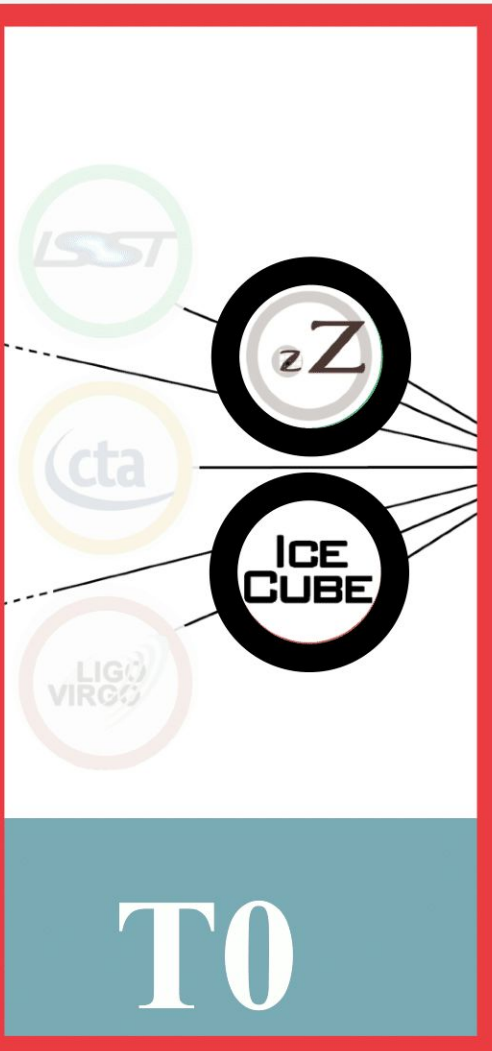


T0

T1/T2

T3

Execution layers

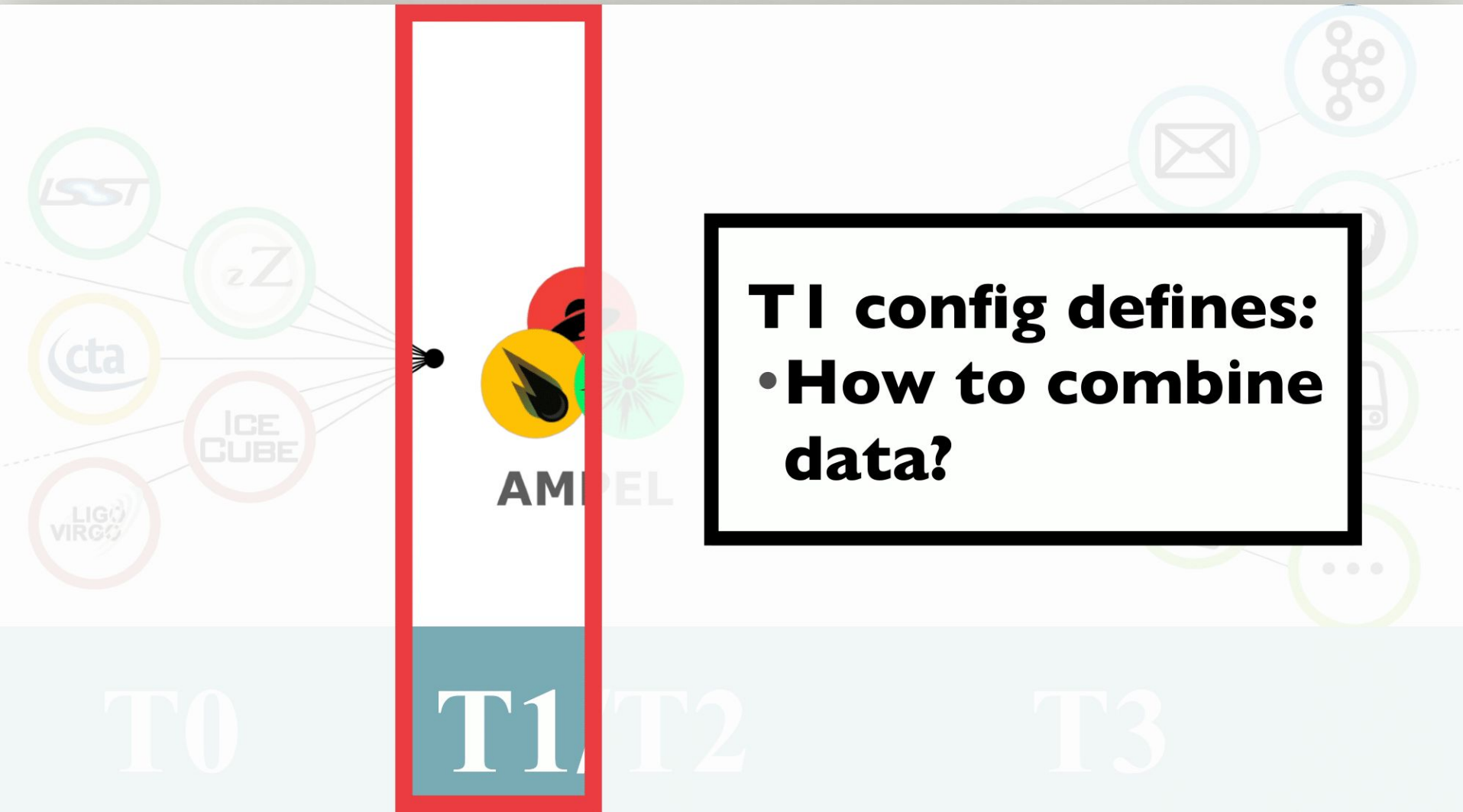


- T0 config *regulates*:**
- **Which instruments?**
 - **Which filters?**

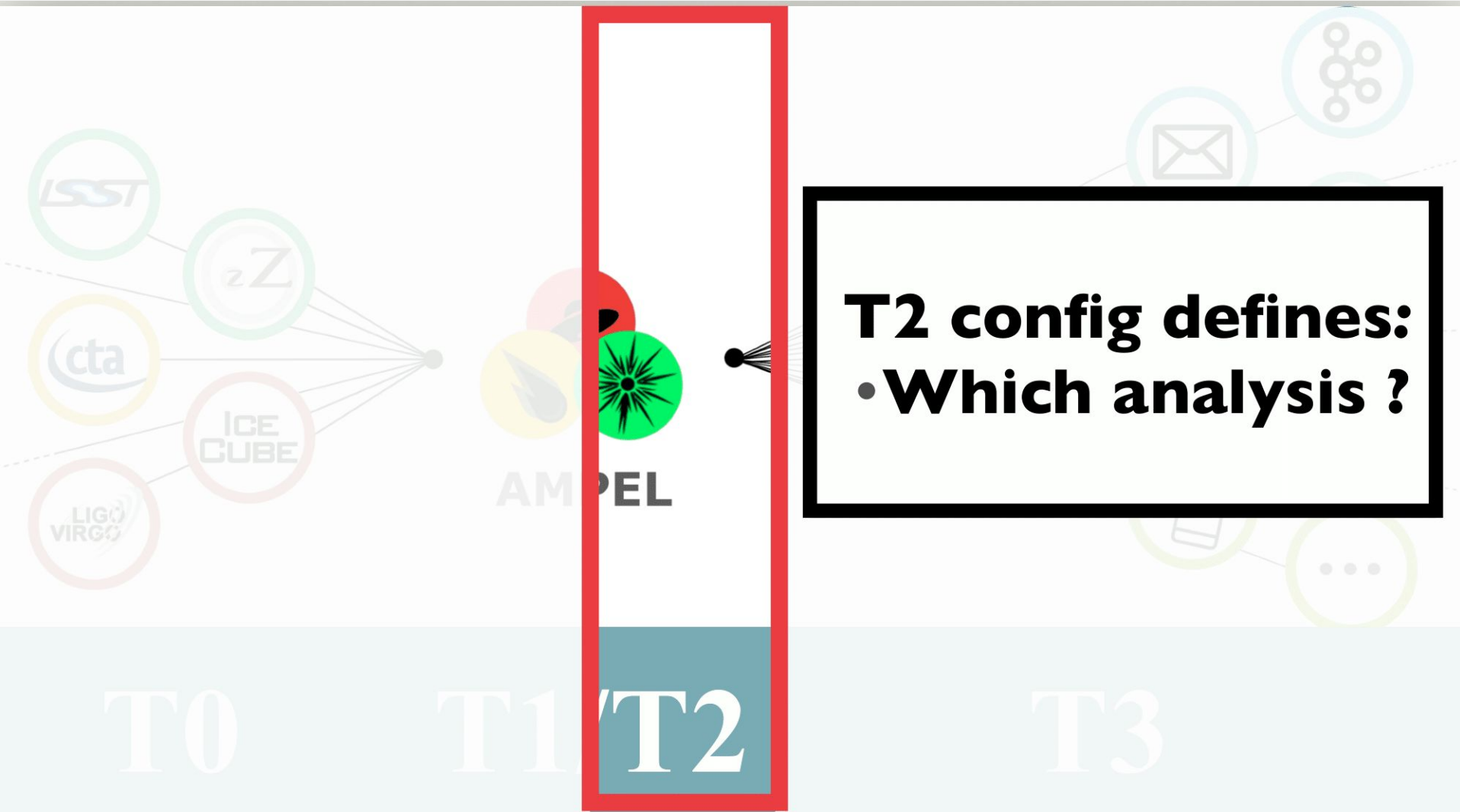
T1/T2

T3

Execution layers



Execution layers



Execution layers

***T3* defines:**

- **Which output?**
- **Which action?**

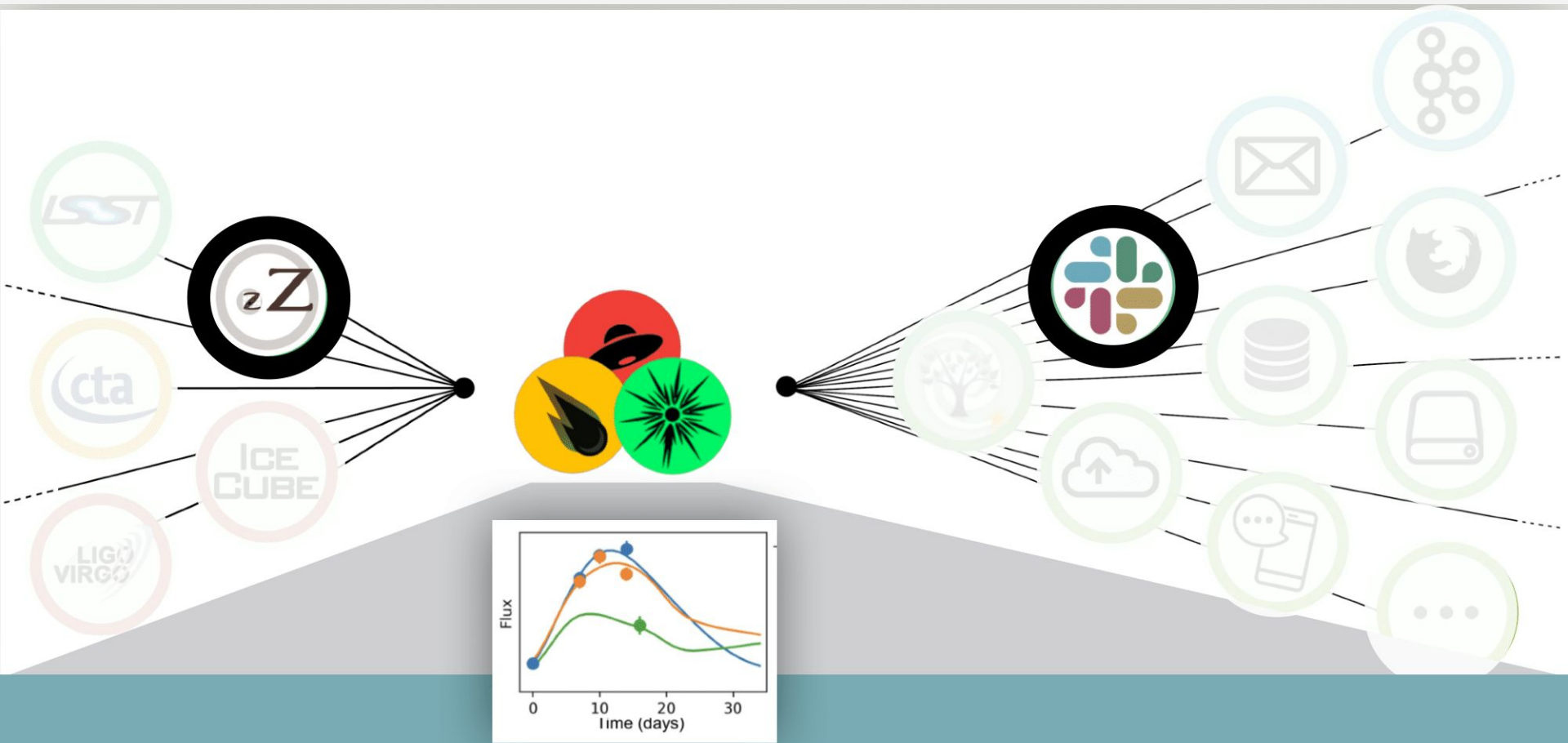


T0

T1/T2

T3

Sample channel



Light curve fit + host info + redshift ...

Execution layers

- *Execution layers* (tiers) replace a traditional pipeline architecture
- Each layer independently scheduled
- Each layer serves distinct purpose
- Information exchange between layers through DB

Channels

- The behaviour of each execution layer configured by *channel*
- A channel defines:
 - What streams to use
 - What analysis to perform
 - When and how to react

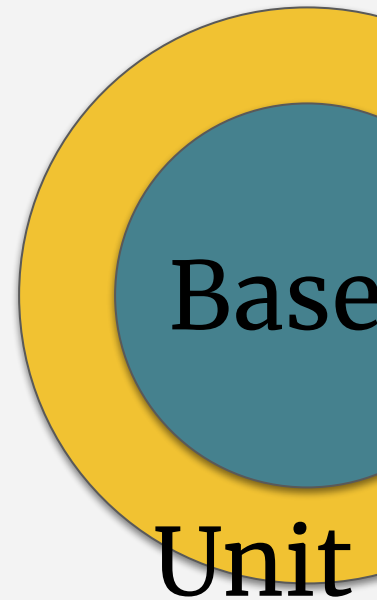
Channels

Ampel then applies this “analysis scheme” consistently to real-time data.

- What analysis to perform
- When and how to react

Analysis units


- Data analysis through python modules
- Abstract classes regulate input / output
 - Use community tools
 - Local tests based on static data
 - Merge into live Ampel instance
- Requested by channels









Analysis units

- Data analysis through python modules

Branch: **master** ▾ [Ampel-contrib-ZTFbh](#) / [ampel](#) / [contrib](#) / [ztfbh](#) / [t3](#) / **T3MarshalPubZTFbh.py** Find file Copy path

 **charlotteaward** Chaning channels.json params and T3 catalog crossmatch cb424c8 on May 8

4 contributors    

151 lines (124 sloc) | 4.77 KB Raw Blame History  

● Code navigation is still being calculated for this commit. Check back in a bit. [Learn more or give us feedback](#)

```
1 from ampel.contrib.hu.t3.MarshalPublisher import MarshalPublisher
2 from ampel.base.abstract.AbsT3Unit import AbsT3Unit
3 from ampel.ztf.pipeline.common.ZTFUtils import ZTFUtils
4 from ampel.base.dataclass.JournalUpdate import JournalUpdate
5 import numpy as np
```

- Requested by channels

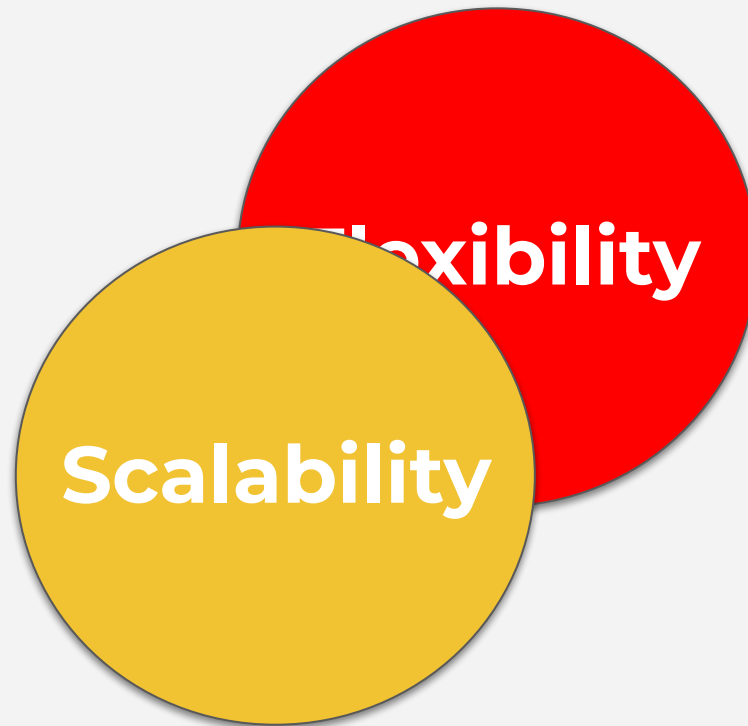
Advantages



Flexibility

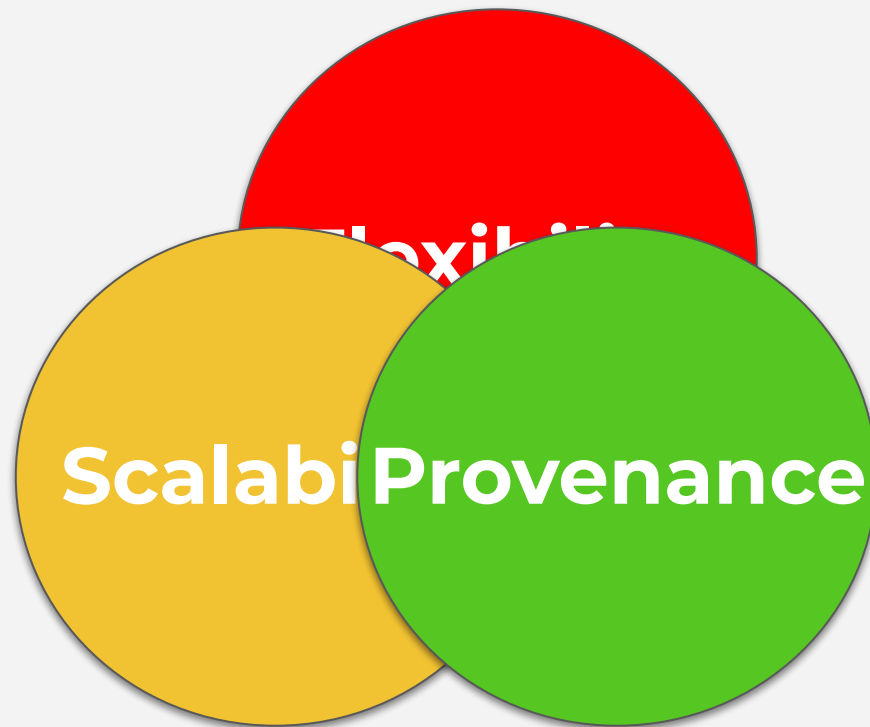
Flexibility

- States enable to combine information from different instruments & versions
- Easy to create new channels
- Modular analysis units
 - Re-use / citation of community work



Scalability

- The execution layer layout enables:
 - Extensive and easy multi-processing
 - Near native distributed computing
- MongoDB scales well horizontally
- Identical computations requested by different channels shared internally



Provenance

- States make computation with dynamic streams traceable and efficient
- Containerisation ensures repeatability
- The transient journal logs everything that happens
- Structured logs enable further efficient analysis
- Compatible with IVOA Provenance Data Model

Summary

- Opportunities through new instruments.
- AMPEL enables novel transient analysis – today
- Public framework
 - Talk to us
 - AMPEL paper (Nordin et al; [2019A&A...631A.147N](#))
 - <https://github.com/AmpelProject/Ampel-contrib-sample>