From ZTF to LSST
Broker to Follow Up Transients
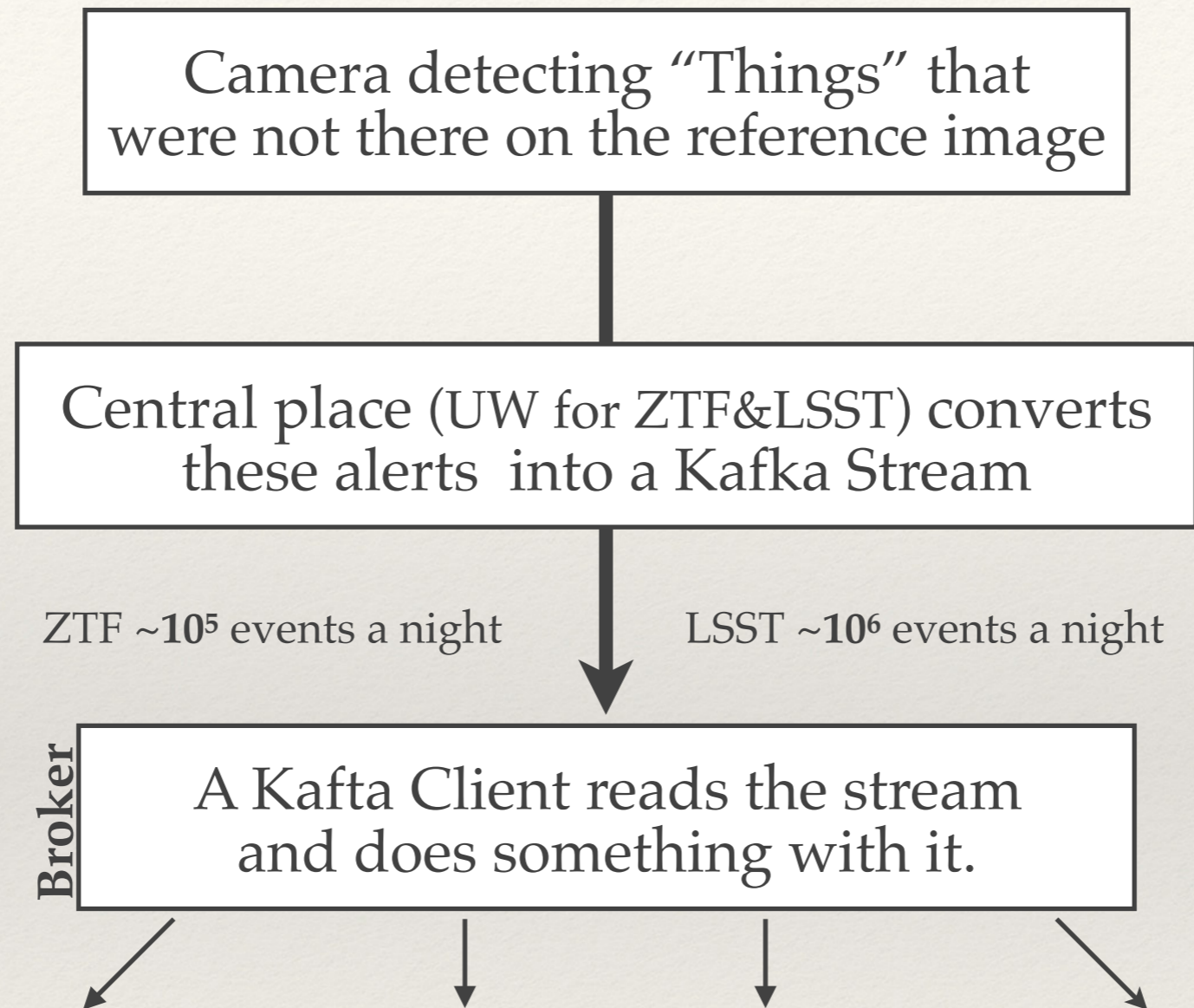
Mickael RIGAULT

ZTF | Go Fast (30s exp.), Scan Large (full visible sky)
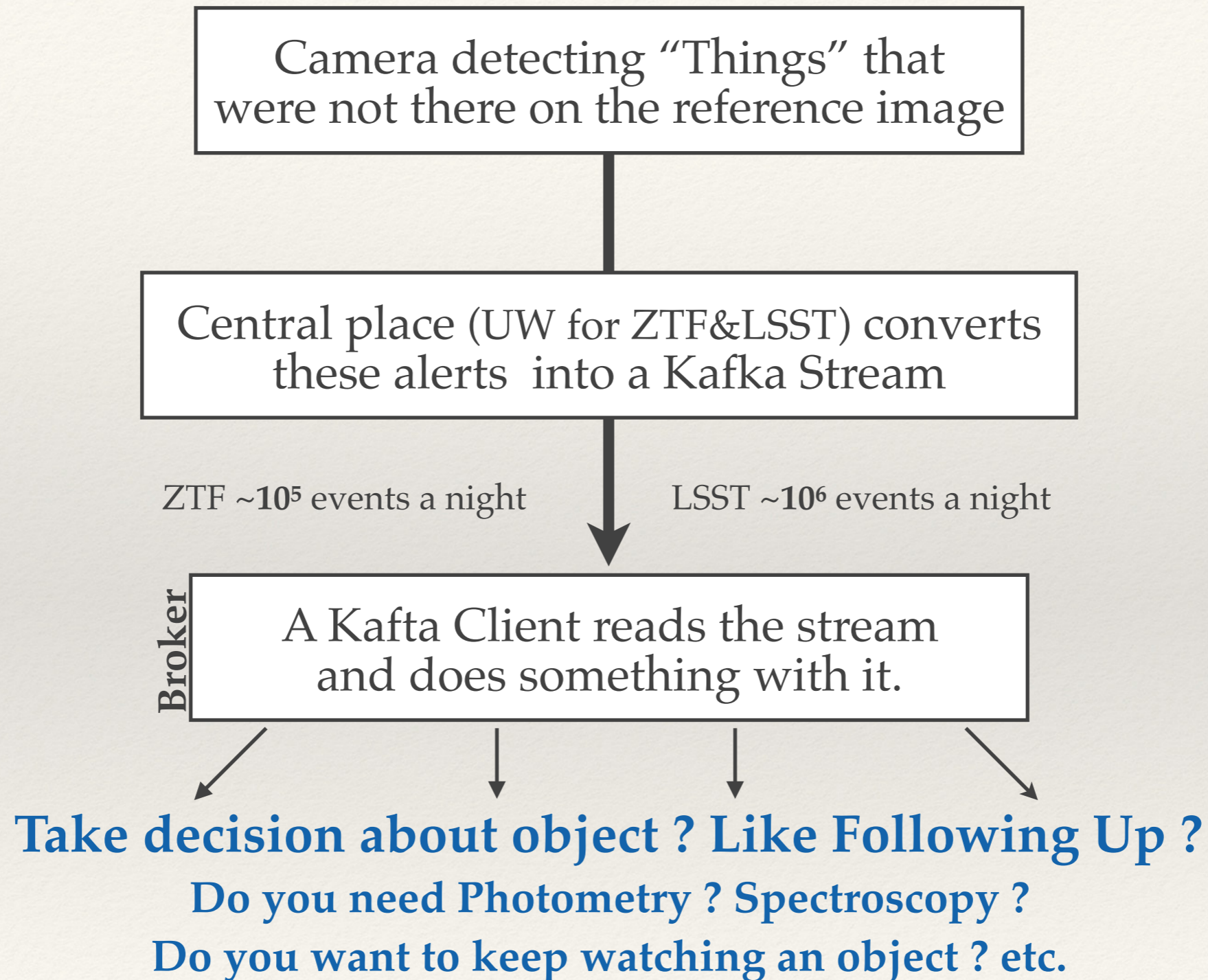
HSC, 1.7 deg^2

MegaCam, 1.0 deg^2

DES, 2.5 deg^2

PTF/iPTF, 7.3 deg^2

ZTF, 47 deg^2

PS1, 7 deg^2

LSST, 9.6 deg^2

1 deg

We have about 10^5 events/night ; 10% of LSST

Why does one need a Broker

Camera detecting "Things" that were not there on the reference image

Central place (UW for ZTF&LSST) converts these alerts into a Kafka Stream

ZTF ~10^5 events a night   LSST ~10^6 events a night

Broker

A Kafta Client reads the stream and does something with it.

Why does one need a Broker

Camera detecting "Things" that were not there on the reference image

Central place (UW for ZTF&LSST) converts these alerts into a Kafka Stream

ZTF ~10^5 events a night

LSST ~10^6 events a night

Broker

A Kafta Client reads the stream and does something with it.

Take decision about object ? Like Following Up ?
Do you need Photometry ? Spectroscopy ?
Do you want to keep watching an object ? etc.

ZTF ~10^5 events a night   LSST ~10^6 events a night

Broker

A Kafta Client reads the stream
and does something with it.

Take decision about object ? Like Following Up ?

Do you need Photometry ? Spectroscopy ?

Do you want to keep watching an object ? etc.

— **AMPEL** —

Alert Management, Photometry and Evaluation of Lightcurves

AMPEL | Concept

The Filter Stage

↓

The Transient DataBase

↓

The Scientific Analyses

↓

The Decisions

AMPEL | SN Example

The Filter Stage

↓

The Transient DataBase

↓

The Scientific Analyses

↓

The Decisions

EXAMPLE | TYPE Ia SUPERNOVA COSMOLOGY

"Give me anything that is rising for at least 5 days in at least 2 different bands"

———

"Keep track of the incoming data and do force photometry if no new data (upper limits)
Re-do photometry if improved software"

———

- Fit SNeIa lightcurve template and derive:
  (1) Expected Maximum & (2) likelihood to be a "Ia"
- Look for a host redshift in catalogs
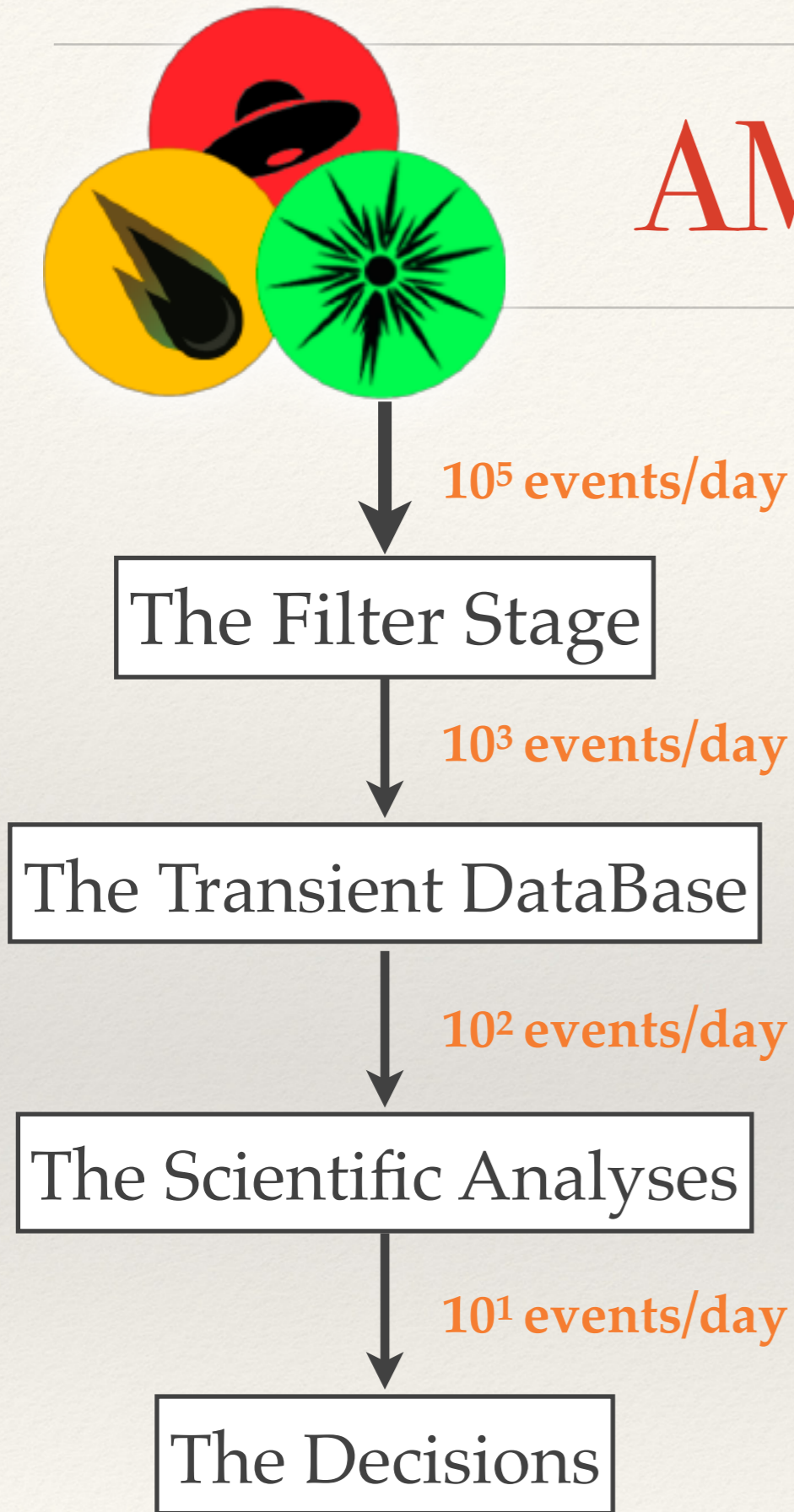 *Derive Photo-z on PanStarrs Data if necessary*

———

Is at max ? *Look for an available spectrograph and get a spectrum* | No signal for 20 days ? *Purge it to the Archive DataBase*

AMPEL | SN Example

10⁵ events/day — 10^5 events/day

The Filter Stage

10^3 events/day

The Transient DataBase

10^2 events/day

The Scientific Analyses

10^1 events/day

The Decisions

EXAMPLE | TYPE Ia SUPERNOVA COSMOLOGY

"Give me anything that is rising for at least 5 days in at least 2 different bands"

———

"Keep track of the incoming data and do force photometry if no new data (upper limits)
Re-do photometry if improved software"

———

- Fit SNeIa lightcurve template and derive:
  (1) Expected Maximum & (2) likelihood to be a "Ia"
- Look for a host redshift in catalogs
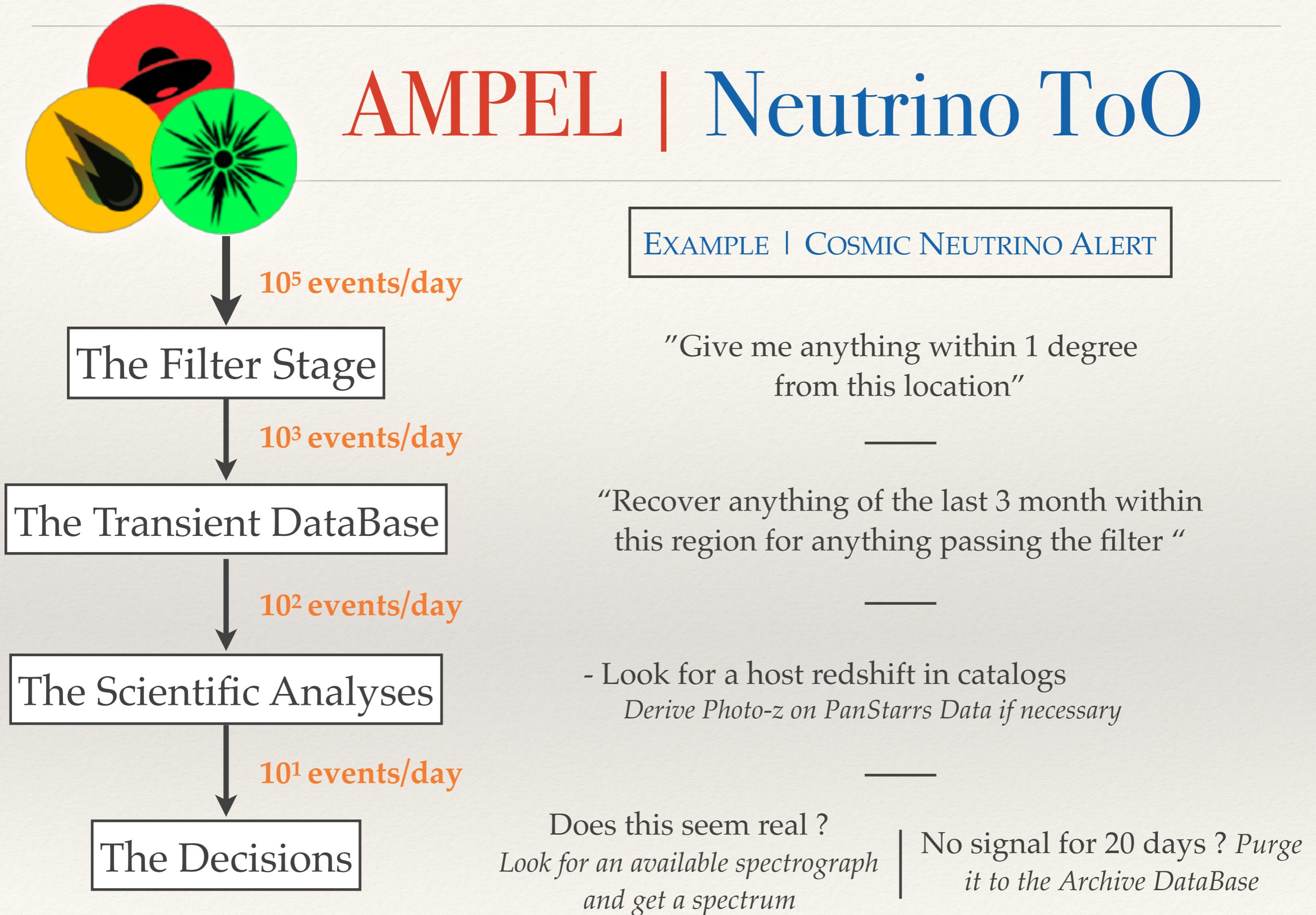 *Derive Photo-z on PanStarrs Data if necessary*

———

Is at max ? *Look for an available spectrograph and get a spectrum* | No signal for 20 days ? *Purge it to the Archive DataBase*
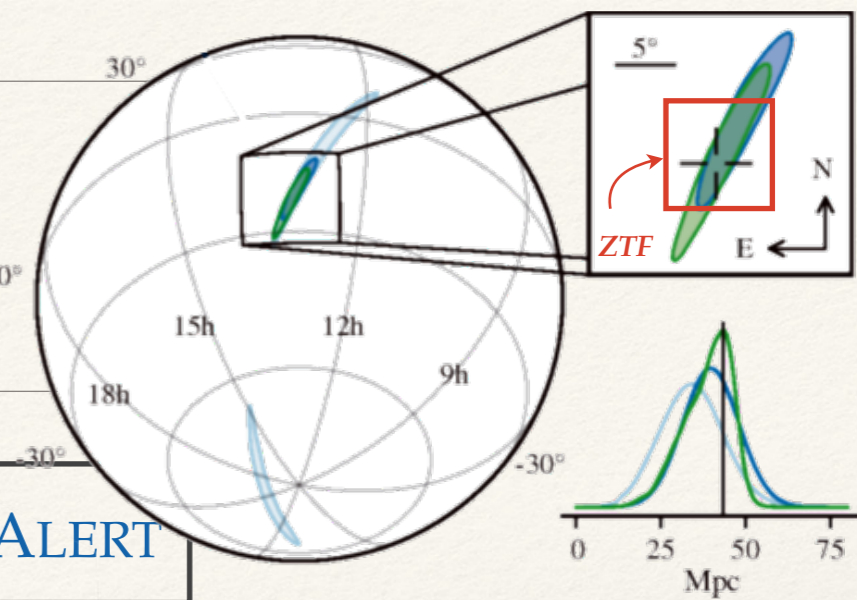
AMPEL | Neutrino ToO

10^5 events/day

The Filter Stage

10^3 events/day

The Transient DataBase

10^2 events/day

The Scientific Analyses

10^1 events/day

The Decisions

EXAMPLE | COSMIC NEUTRINO ALERT

"Give me anything within 1 degree
from this location"

———

"Recover anything of the last 3 month within
this region for anything passing the filter "

———

- Look for a host redshift in catalogs
  Derive Photo-z on PanStarrs Data if necessary

———

Does this seem real ?
*Look for an available spectrograph
and get a spectrum*

No signal for 20 days ? *Purge
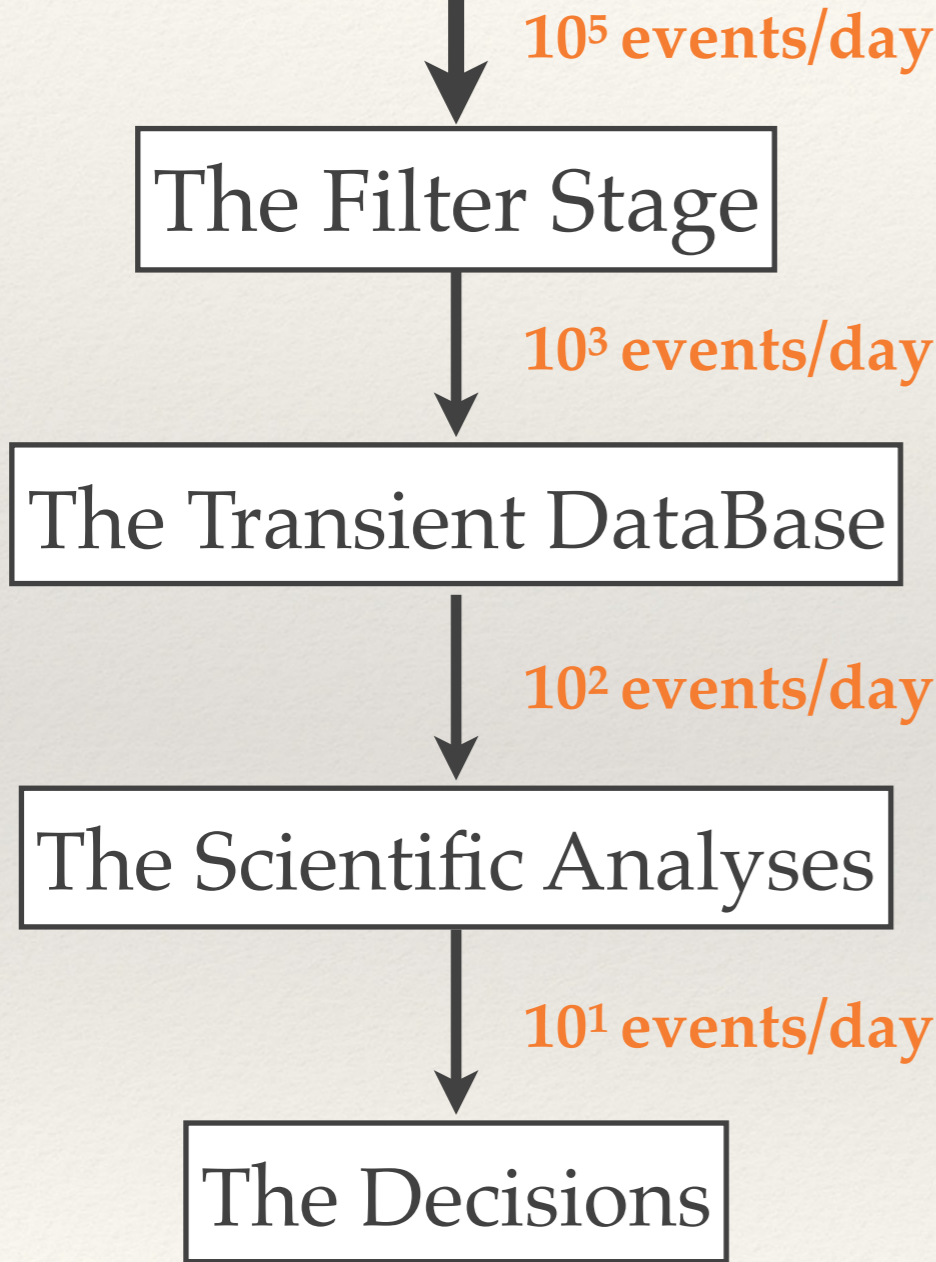it to the Archive DataBase*

AMPEL | GW ToO

Abbot et al. (2017), PRL 119, 161101

10^5 events/day

The Filter Stage

10^3 events/day

The Transient DataBase

10^2 events/day

The Scientific Analyses

10^1 events/day

The Decisions

EXAMPLE | GW ALERT

"Give me anything within the location contours"

———

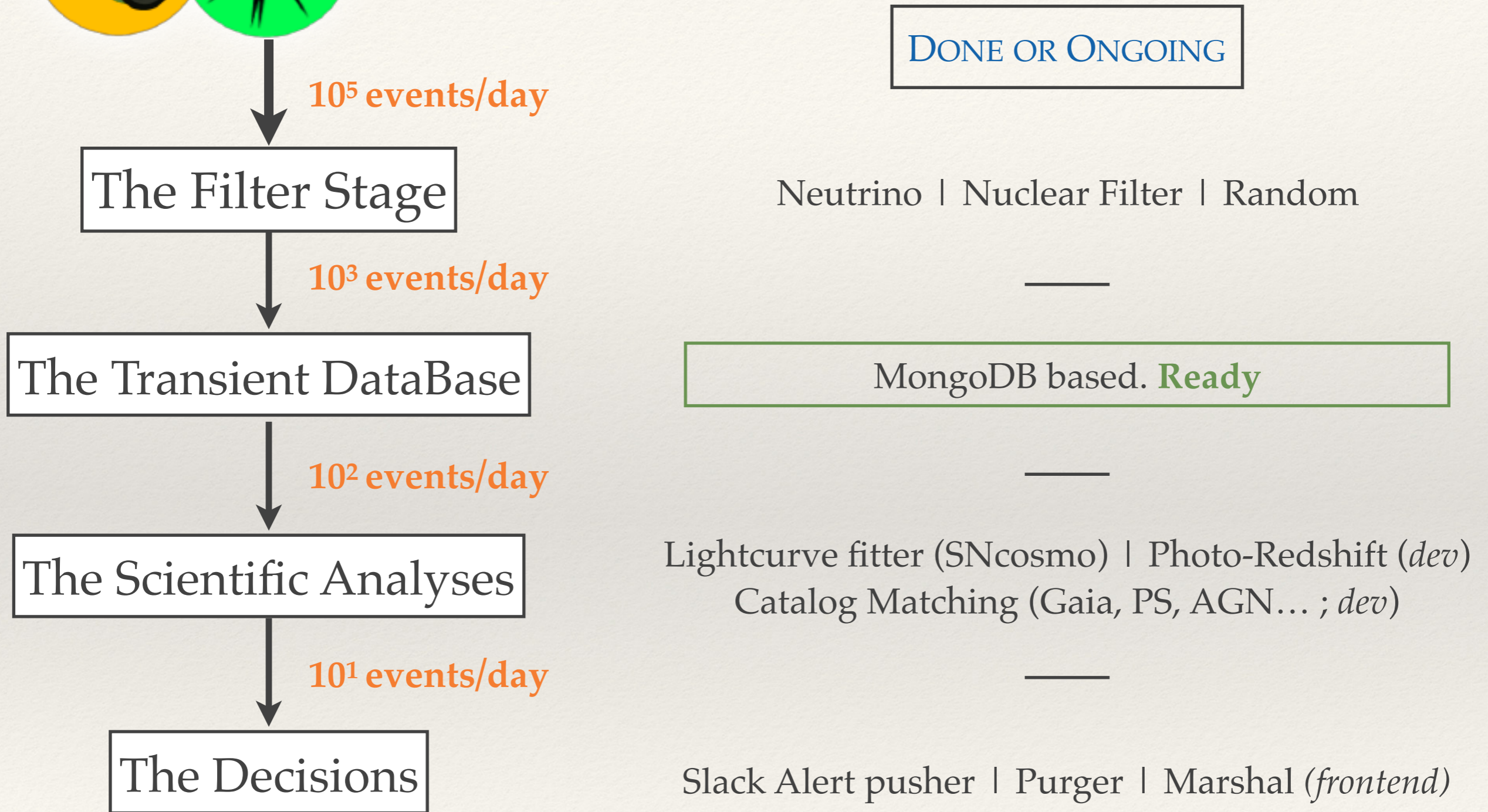"Recover every former alerts within the last 2 days that could have passed the new cut "

———

- Look for a host redshift in catalogs
  Derive Photo-z on PanStarrs Data if necessary

- Check galaxy catalogs and give *p(host)*

———

Does this seem real ?
Look for an available spectrograph and get a spectrum

No signal for 10 days ? *Purge it to the Archive DataBase*

AMPEL | Development

10^5 events/day

The Filter Stage

10^3 events/day

The Transient DataBase

10^2 events/day

The Scientific Analyses

10^1 events/day

The Decisions

Neutrino | Nuclear Filter | Random

—

MongoDB based. **Ready**

—

Lightcurve fitter (SNcosmo) | Photo-Redshift (*dev*)
Catalog Matching (Gaia, PS, AGN… ; *dev*)

—

Slack Alert pusher | Purger | Marshal (*frontend*)

Jakob Nordin
Principal Investigator

Valery Brinnel
Lead Developer

Jakob von Santen
Hardware, Network, Storage

Ludwig Rauch & Mickael Rigault
Science analysis packages

Matteo Giomi & Robert Stein
Filters, Catalogs DB

— (part of) Marek Kowalski's Group —

Jakob Nordin
Principal Investigator

Valery Brinnel
Lead Developer

You could help
Add your science packages
Share your follow up facility

You could use it for MSIP
Just build your Filter
& Channel (Filter + Science + Decision)

Do not hesitate to contact us
ampel-info@desy.de

ZTF | Camera & Spectros

ZTF Camera (P48)

SEDmachine (IFU P60)

Long slit (P60)

The SED-machine

Installed in the P60 (1.50m):   *Could reach M~-19mag up to z~0.1*

A low (R~100) resolution spectra: *Good enough to type (explosion = broad lines)*
(wavelength step ~30A)

Integral Field Unit 30 x 30 arcsec²: *Easy positioning ; minimal slew time*
Bonus : Host signal

Dedicated ZTF instrument   *Maximize the Typing power ; selection effect etc.*

Cheap !   *We should build more !*
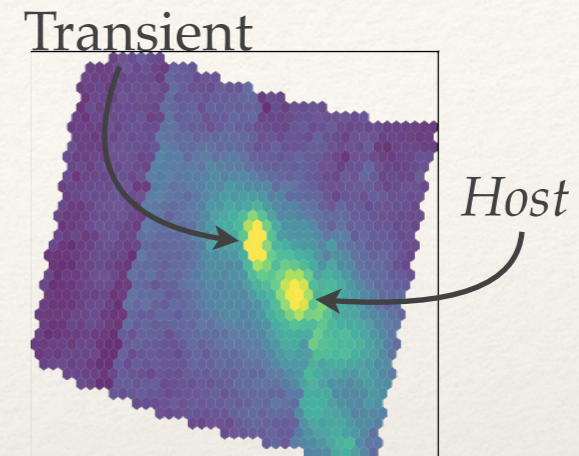
Conclusion

Transient
Host

AMPEL

The tool develop by the ZTF to:

- **Read & store** *the Alert stream*

- **Filter** *the Stream !*

- *Do* **science analysis** *on incoming data*

- *Helps you* **taking decision**

- **Schedule follow-up**

Typing ? SEDm !

Dedicated ZTF instrument for Typing

- *Low resolution spectra for* **Typing**

- *Can reach* **mag 19.5** *in ~30min.*

- *Could* **type** *about* **20 objects a night**

- **pysedm** *made* **flexible** *; ready for more*

We need more SEDM-like instruments