



Time-domain analysis with the ANTARES event broker

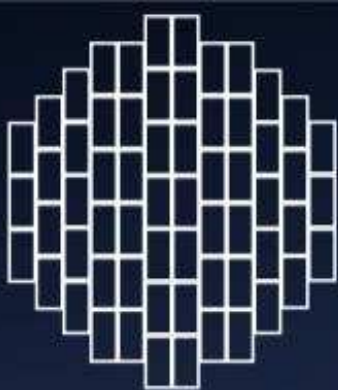
<https://antares.noirlab.edu>

Chien-Hsiu Lee, on behalf of the ANTARES team:

Thomas Matheson, Abhijit Saha, Gautham Narayan, Monika Soraisam, Carl Stubens, Nicholas Wolf, Richard Snodgrass, John Kececioglu, Carlos Scheidegger

Jan 12, 2021 @ AAS 237

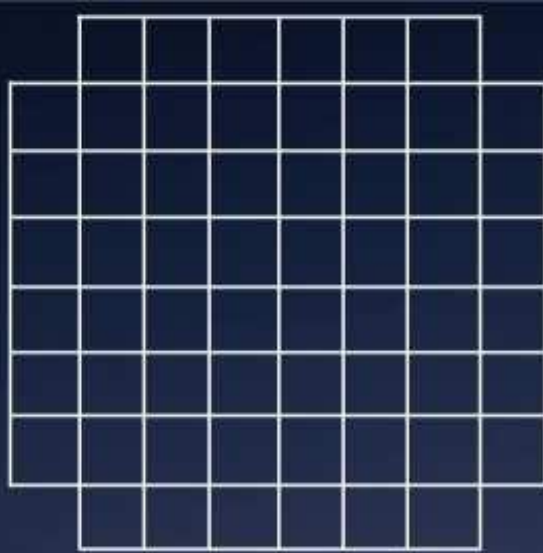
DES,
2.5 deg²



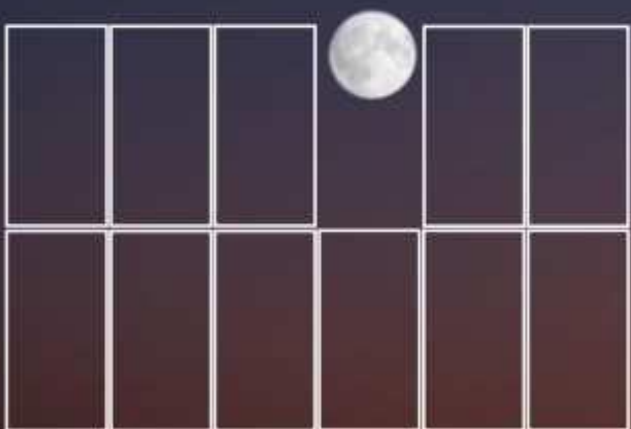
SDSS,
3 deg²



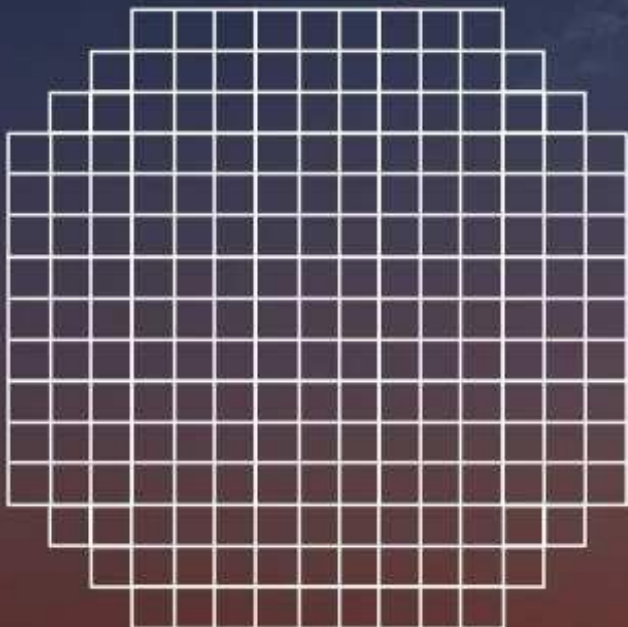
PS1, 7 deg²



PTF/iPTF, 7.3 deg²



LSST, 9.6 deg²

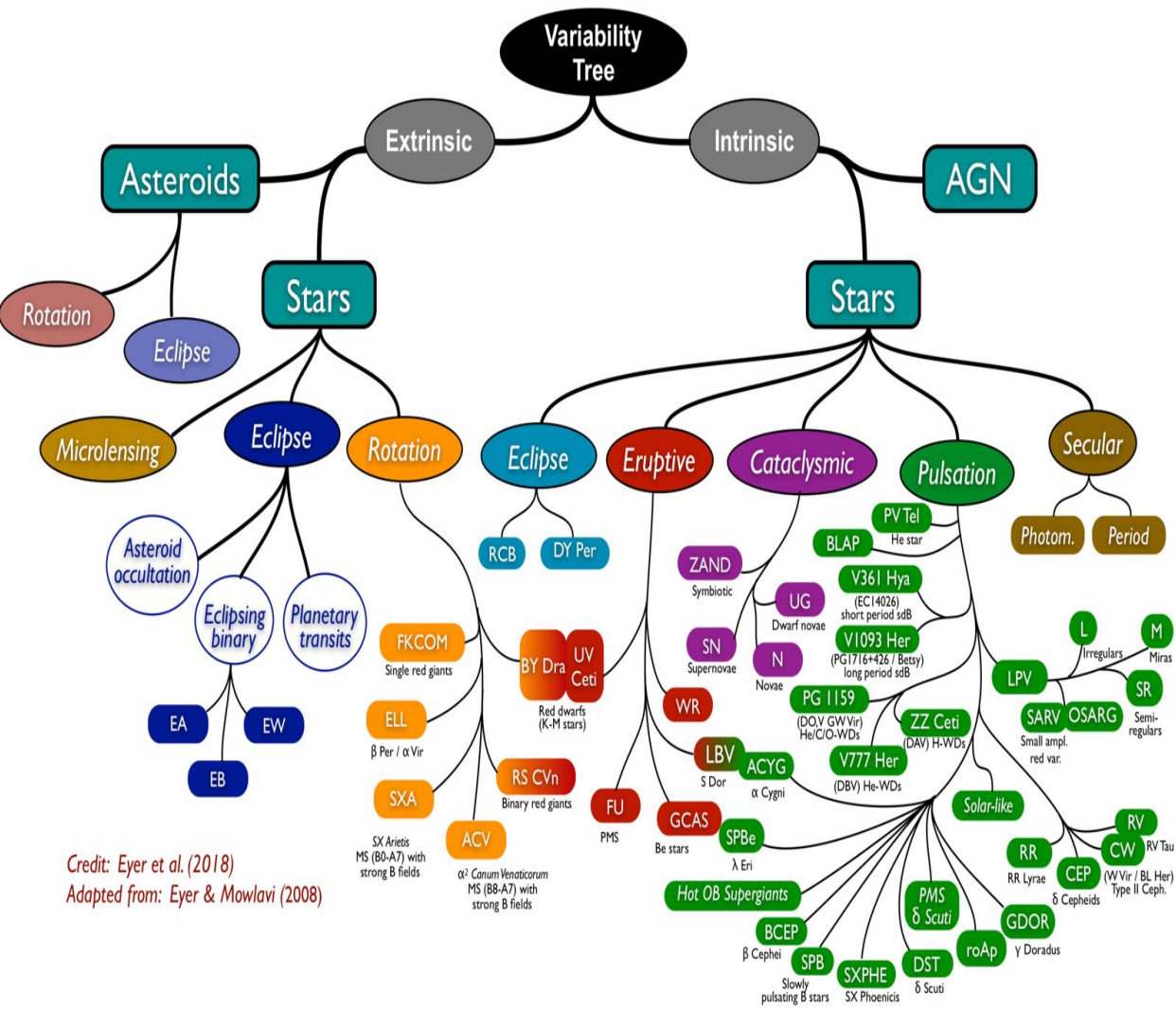


ZTF, 47 deg²

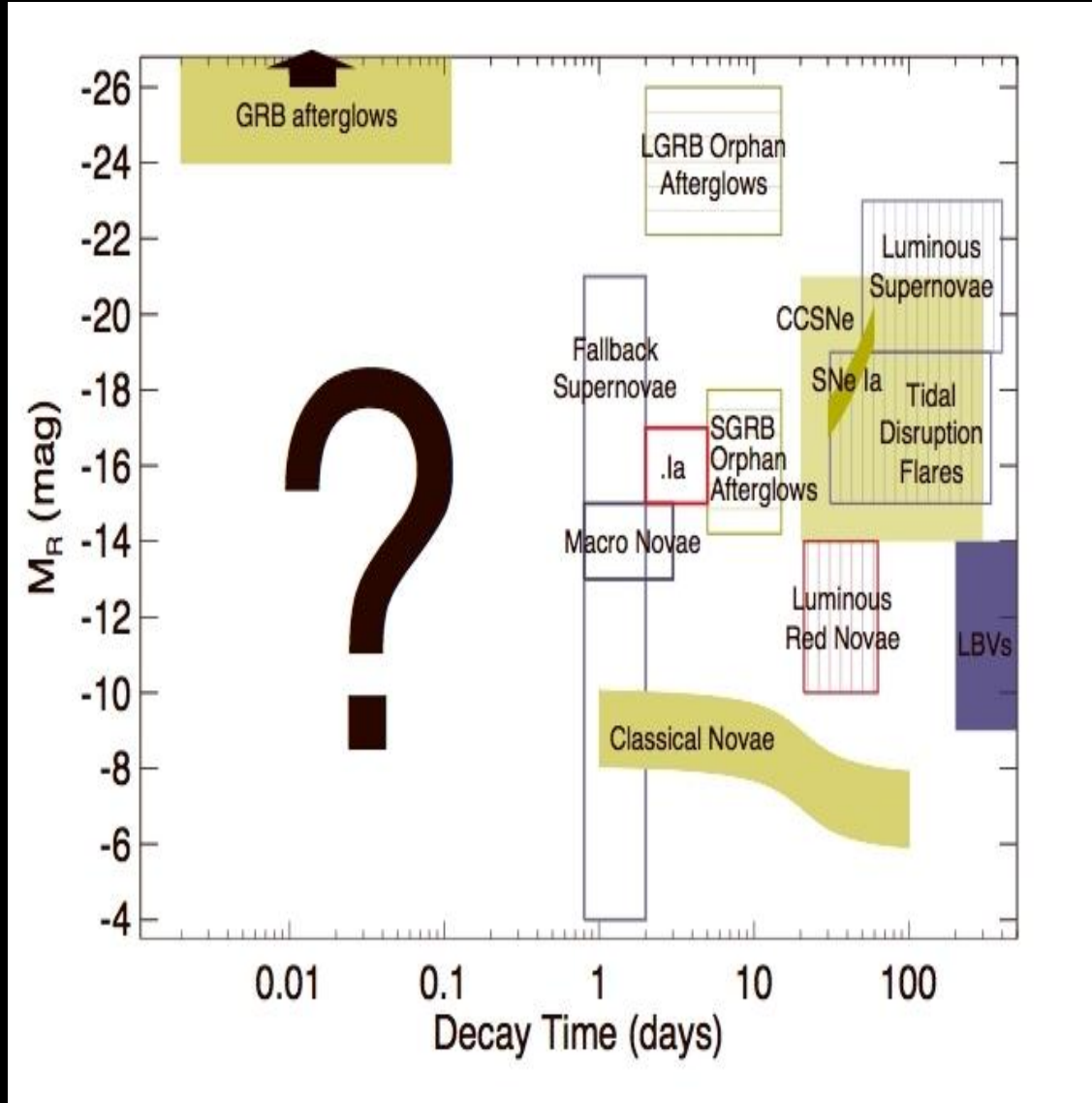


ZTF: 10⁵ alerts per night

LSST: 10⁷ alerts per night

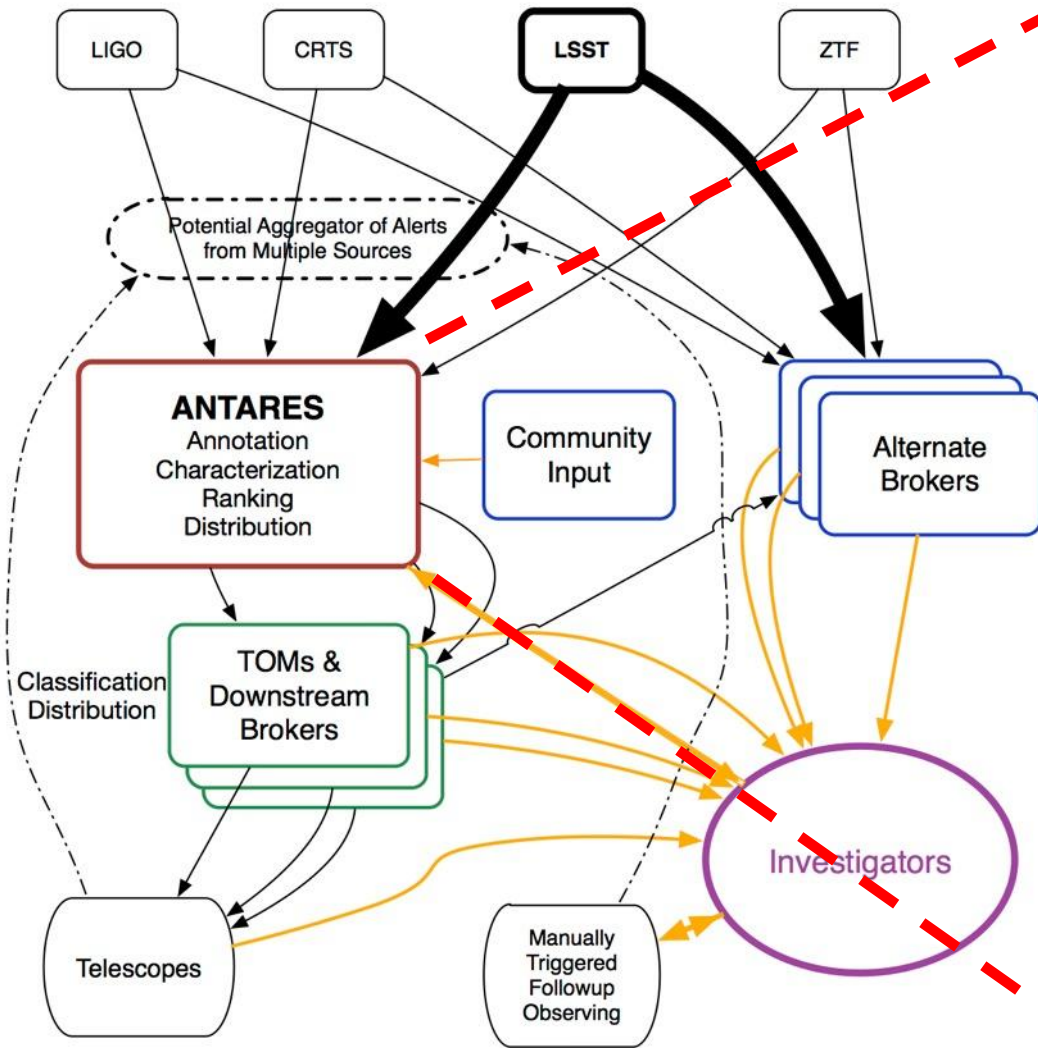


Credit: Eyer et al. (2018)
Adapted from: Eyer & Mowlavi (2008)



ANTARES Environment

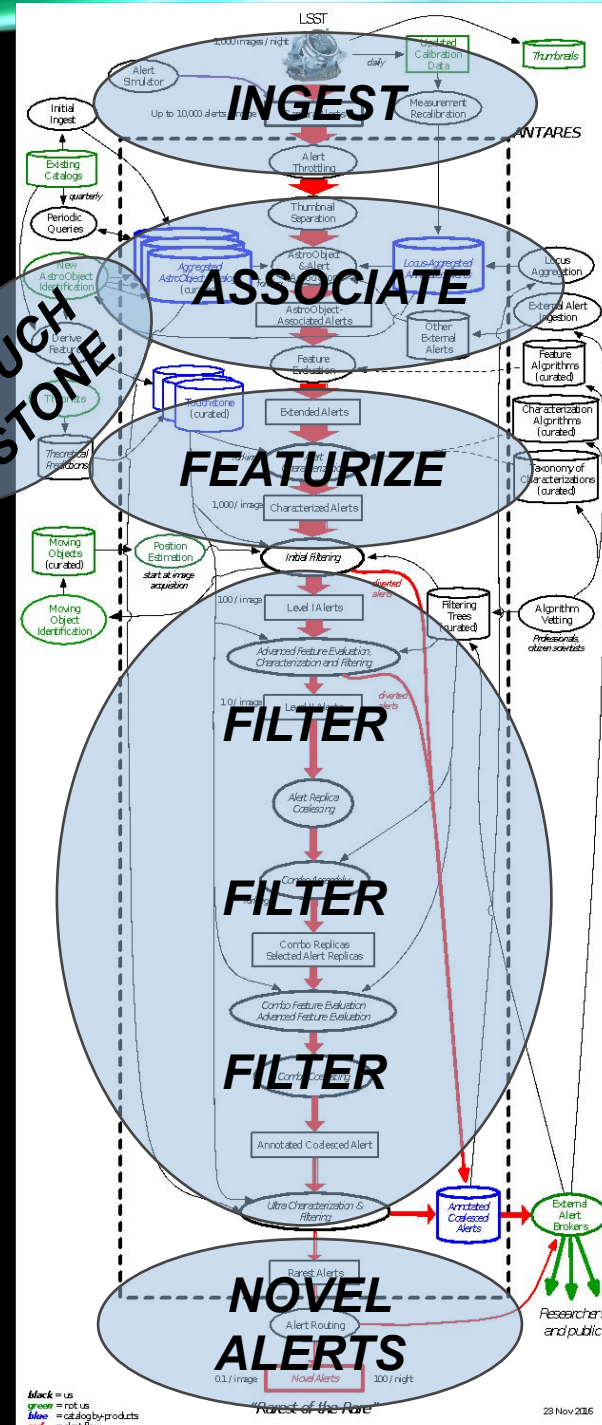
ALERT GENERATORS: Difference Imaging, Real/Bogus & Moving Object Assessment



System Data Flow
Info to/from Investigators
Feedback



TOUGH STONE



10 million / night

100 / night

Tags

Filters can add Tags to Loci. Each Tag is produced by a single Filter.

Name	Description	Actions
extragalactic	Locus is associated (either random or real) with extended source(s).	View Loci
nuclear_transient	Locus has one or more Alerts in the nuclear region (<0.6 arcseconds) of a source in the ZTF reference frame.	View Loci
sso_confirmed	A subset of 'sso_candidates' with positional uncertainties and positional residuals between predicted and measured positions are less than one arcsec as compared to JPL Horizons ephemerides.	View Loci
high_snr	Locus with alert(s) having high signal-to-noise ratio (SNR).	View Loci
high_flux_ratio_wrt_nn	Locus with alert(s) exhibiting a large change in flux with respect to its nearest neighbor (within 1 arcsec) flux	View Loci
high_amplitude_variable_star_candidate	Locus - a variable star candidate - exhibits a high amplitude	View Loci
high_amplitude_transient_candidate	Locus - a transient candidate - exhibits a high amplitude	View

Building the Infrastructure for Time-Domain Alert Science in the LSST Era

May 22-25, 2017 • Tucson, AZ



Broker



Real-time alert filtering




Science platform



Long-term alert exploration



DEMO OF WEBPORTAL

Lookup Object by ID 

[Explore](#) [Favorites](#) [Filters](#) [Tags](#) [Watch Lists](#) [Catalogs](#) [Pipeline](#) [Properties](#) FAQ Chien-Hsiu Lee ▾

Latest Alert Within

First Alert Within

Number of Measurements

1

Cone Search

Center:

Radius:

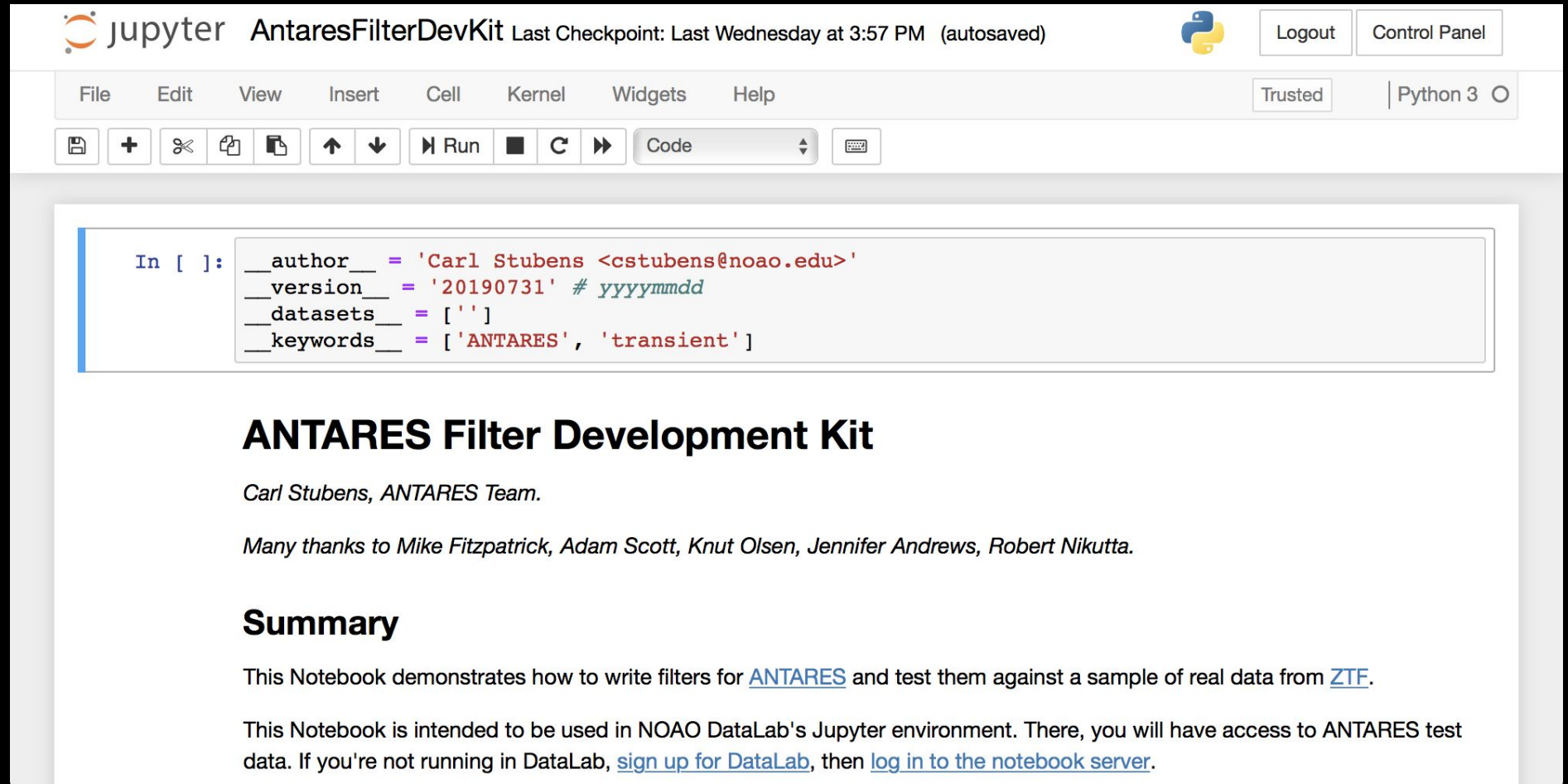
Catalogs

- gaia_dr2 (17.6M)
- 2mass_psc (16.6M)
- allwise (16.1M)
- bright_guide_star_cat (15.8M)
- sdss_stars (3.8M)
- asassn_variable_catalog_v2_20190802 (242.0k)

Showing 1-10 of 10000

ID	ZTF ID	RA	Dec	Latest Mag	Brightest Mag	# Alerts	Latest Alert	F
ANT2020ae7ddzq	ZTF20actlngx	178.80	2.49	16.86	16.86	1	2020-11-23 13:29:22	20
ANT2020as4fk	ZTF17aaapkjr	178.80	6.00	17.90	17.51	87	2020-11-23 13:29:22	20
ANT2020ae7deli	ZTF20actlnka	179.28	7.82	17.94	17.94	1	2020-11-23 13:29:22	20
ANT2020atvhu	ZTF18acrmxui	180.36	8.11	17.24	15.11	19	2020-11-23 13:29:22	20
ANT2020ae2tu2y	ZTF19abbzbgh	179.03	3.03	17.43	16.71	7	2020-11-23 13:29:22	20
ANT2020bgq5a	ZTF18acyxmoc	176.23	7.65	15.88	15.41	23	2020-11-23 13:29:22	20
ANT2020ae7dd6a	ZTF20actlnie	179.63	3.01	18.64	18.64	1	2020-11-23 13:29:22	20
ANT2020ae7dema	ZTF20actlnkb	178.79	7.89	19.19	19.19	1	2020-11-23 13:29:22	20
ANT2020ae7depa	ZTF20actlnkt	181.52	1.45	19.23	19.23	1	2020-11-23 13:29:22	20
ANT2020ae7dezi	ZTF20actlnmr	175.21	2.30	18.98	18.98	1	2020-11-23 13:29:22	20

DEMO OF FILTER DEVKIT



The image shows a Jupyter Notebook interface. At the top, the title bar reads "jupyter AntaresFilterDevKit Last Checkpoint: Last Wednesday at 3:57 PM (autosaved)". There are "Logout" and "Control Panel" buttons on the right. Below the title bar is a menu bar with "File", "Edit", "View", "Insert", "Cell", "Kernel", "Widgets", and "Help". On the right of the menu bar, there are "Trusted" and "Python 3" indicators. Below the menu bar is a toolbar with icons for saving, adding, deleting, copying, pasting, undo, redo, and running code. The main content area contains a code cell with the following Python code:

```
In [ ]: __author__ = 'Carl Stubens <cstubens@noao.edu>'
__version__ = '20190731' # yyyyymmdd
__datasets__ = []
__keywords__ = ['ANTARES', 'transient']
```

Below the code cell is a text cell with the following content:

ANTARES Filter Development Kit

Carl Stubens, ANTARES Team.

Many thanks to Mike Fitzpatrick, Adam Scott, Knut Olsen, Jennifer Andrews, Robert Nikutta.

Summary

This Notebook demonstrates how to write filters for [ANTARES](#) and test them against a sample of real data from [ZTF](#).

This Notebook is intended to be used in NOAO DataLab's Jupyter environment. There, you will have access to ANTARES test data. If you're not running in DataLab, [sign up for DataLab](#), then [log in to the notebook server](#).

DEMO OF EXPLORING ANTARES ALERT DATABASE

```
In [1]: __author__ = 'Chien-Hsiu Lee <lee@noao.edu>, Thomas Matheson <matheson@noao.edu>'
__version__ = '2020730' # yyyymmdd
__datasets__ = []
__keywords__ = ['ANTARES', 'variable']
```

Exploring Elastic Search Database to Find R Corona Borealis Stars

Chien-Hsiu Lee, Thomas Matheson & ANTARES Team

Table of contents

- [Goals & notebook summary](#)
- [Disclaimer & Attribution](#)
- [Imports & setup](#)
- [Querying ANTARES alert database](#)
- [Inspecting light curves](#)
- [Resources and references](#)

Goals

This notebook is an example of how to explore the ANTARES alert database for variable stars. Here we use the infrared color selection of candidate R Coronae Borealis stars, and search the ZTF time-series photometry to see if there are unknown R CrBs