NSF's National Optical-Infrared Astronomy Research Laboratory

AURA

ANTARES and ZTF

Tom Matheson

Abi Saha, Gautham Narayan, Monika Soraisam, Chien-Hsiu Lee, Carl Stubens, Nic Wolf, Pete Peterson, Adam Scott, Steve Ridgway, Rick Snodgrass, Carlos Scheidegger, John Kececioglu

https://antares.noirlab.edu/

October 23, 2020

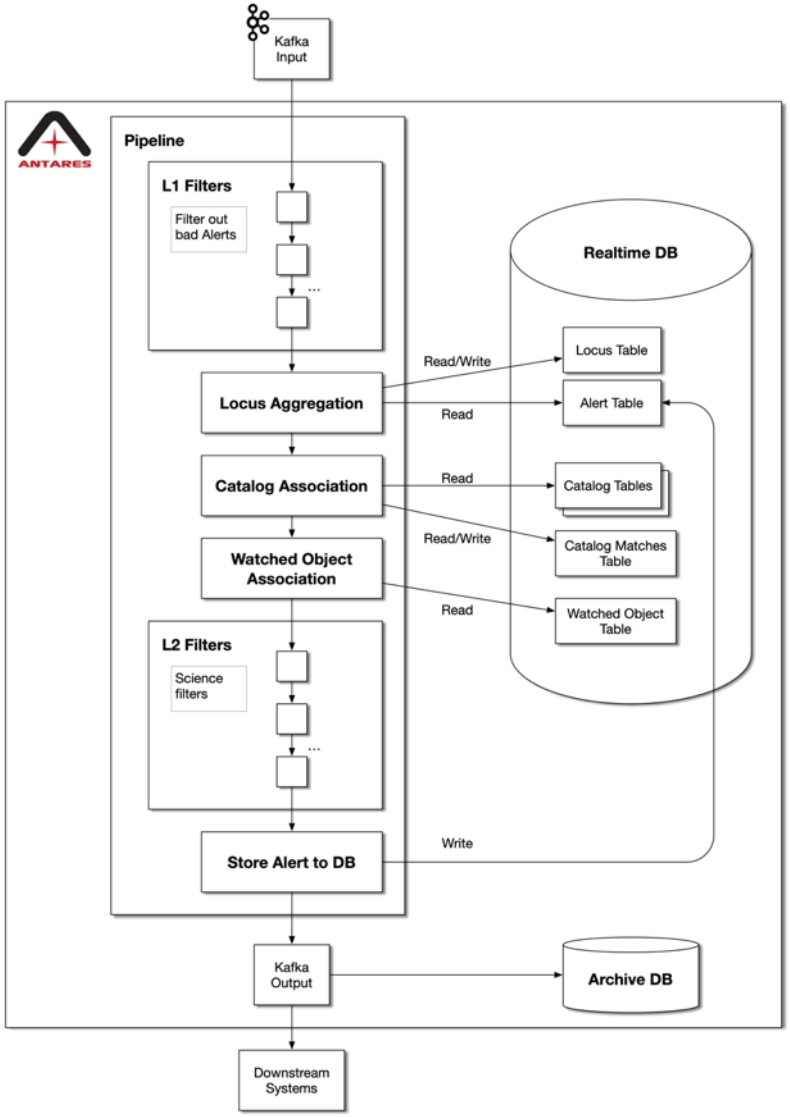
NSF's National Optical-Infrared Astronomy Research Laboratory

ANTARES Overview

- Enabling broad scientific use of time-domain alerts
- Efficient, effective, responsive, open, and flexible brokering system
  - Real-time alert processing
  - Scalable to LSST rate and volume
  - Community driven platform
  - No user restrictions
- Actively processing ZTF public alerts
  - https://antares.noirlab.edu/

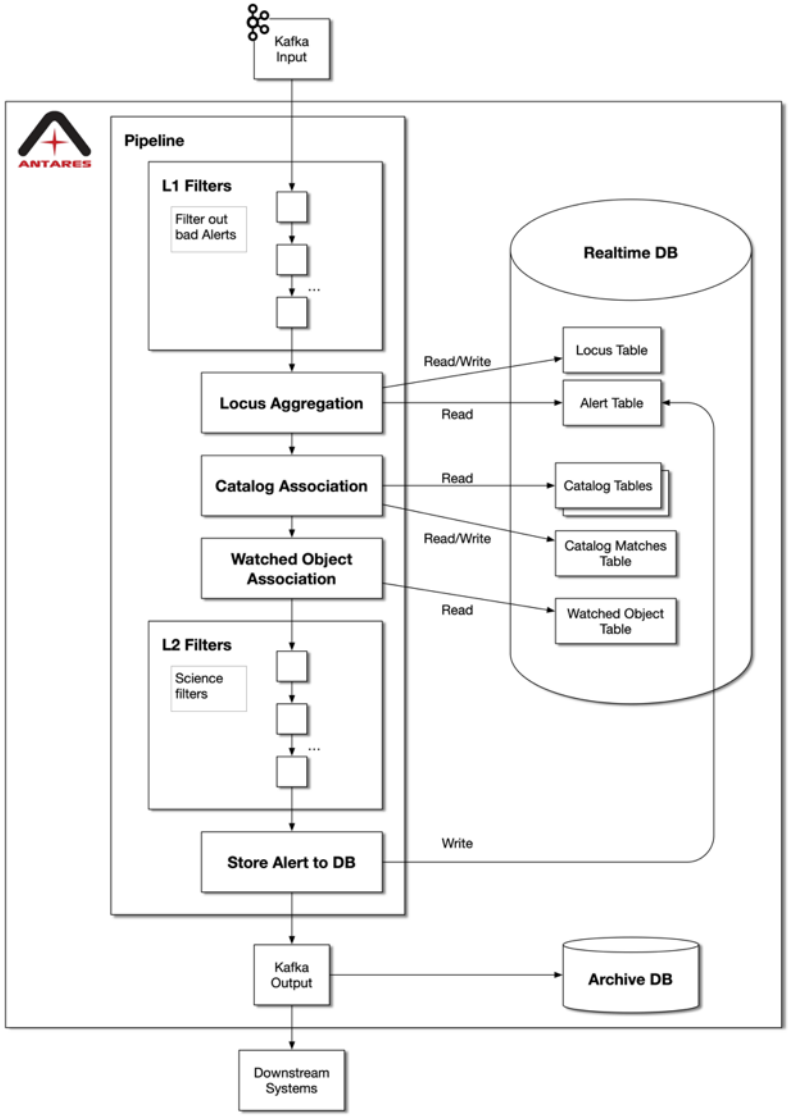
ANTARES Features

- Kubernetes-based deployment
- Kafka streaming
- Annotation from catalogs
- Filtering of alerts
- Searchable archive of alerts
- Watch lists
- Web portal displays streams, filters, light curve, thumbnails, pipeline, associations
- Provenance associated with each alert



ANTARES Filters

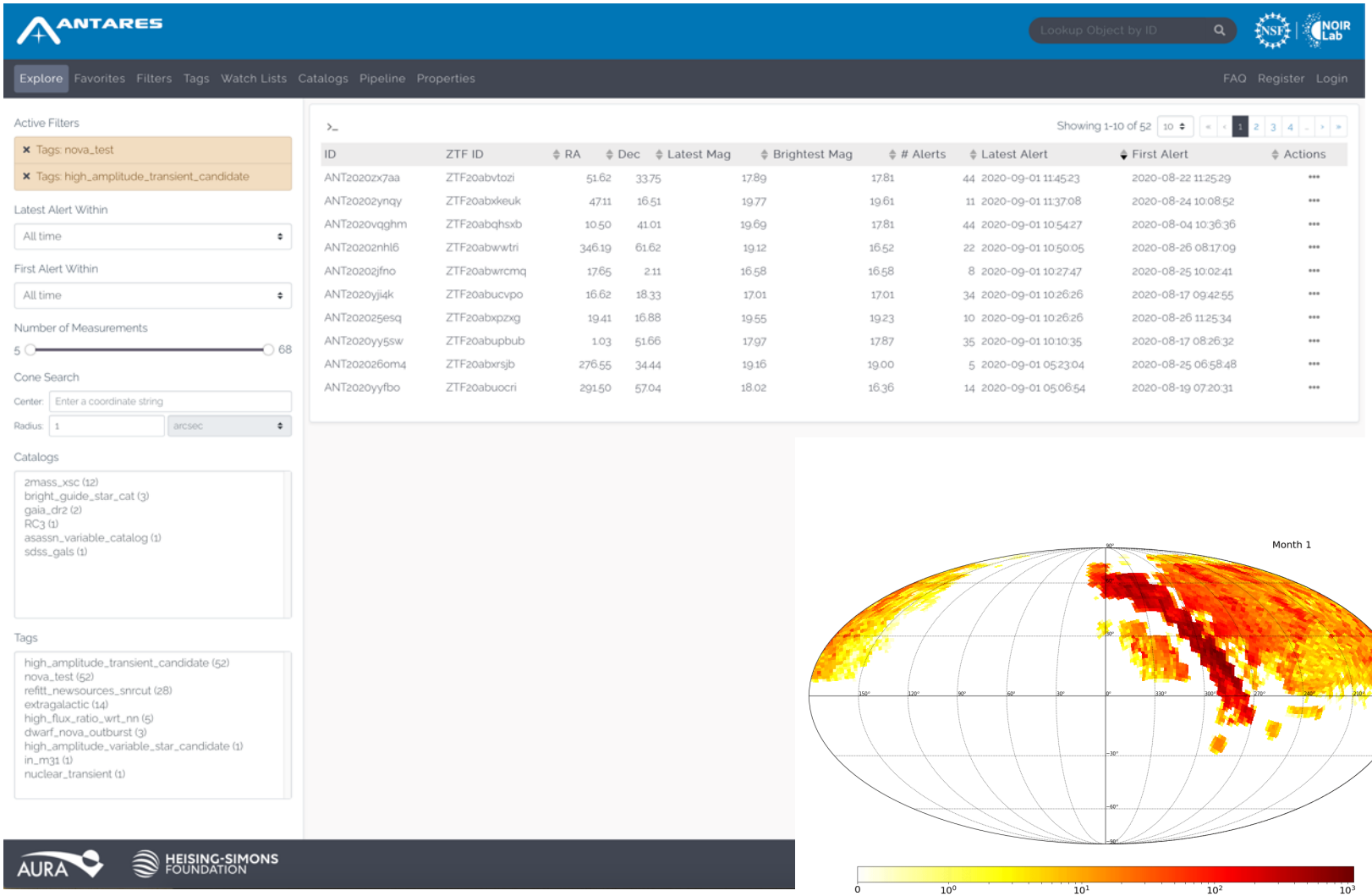
- Near Known Extragalactic objects
- Bright or high significance
- In M31
- Nuclear transient
- Known Solar System objects
- Near potential tidal disruption hosts (contributed catalog)
- Gravitational wave counterparts
- AstroRAPID



ANTARES Data Products

- Annotated alerts
  - Feature calculation
  - External catalogs (e.g., catsHTM)
- Filtered alerts
  - Access to all alert features including annotations
  - Can be user designed, dev kit on Astro Data Lab
- Output three ways
  - Web portal
  - Slack Channel (antares-noao.slack.com)
  - Kafka streams (Python API; could be full stream)
- Archive
  - Longer timescale analysis

ANTARES Web Portal



ANTARES Science

147 ANTARES-flagged SN candidates confirmed in TNS (40% early) from Aug 2019 to Mar 2020

Many dwarf novae and novae

Table 1. Summary of ATels by ANTARES team and collaborations

ATel#	Name	Classification	Report date	Facilities
12935	ZTF19aazcxwk	SN Ia	07/12/2019	LCO 2m telescope
12943	ZTF19abfqlzi	M31 recurrent nova	07/15/2019	Gemini telescope
12946	ZTF19abdooly	dwarf nova	07/18/2019	LCO 2m telescope
12980	ZTF19abgsssu	dwarf nova	08/02/2019	Shane 3m Telescope, Lick Observatory
13053	ZTF19abpmetl	SN Ia	08/30/2019	Shane 3m Telescope, Lick Observatory
13055	ZTF19abraqpf	dwarf nova	08/30/2019	Shane 3m Telescope, Lick Observatory
	ZTF19abqstxq	dwarf nova	08/30/2019	Shane 3m Telescope, Lick Observatory
13115	ZTF19abtuflm	SN II	09/18/2019	Shane 3m Telescope, Lick Observatory
13119	ZTF19abpvysx	SN Ia	09/21/2019	Shane 3m Telescope, Lick Observatory
	ZTF19abrelog	SN Ia-91T	09/21/2019	Shane 3m Telescope, Lick Observatory
	ZTF19abulrfa	SN IIP	09/21/2019	Shane 3m Telescope, Lick Observatory
13141	M31N2019-09b	M31 nova	09/28/2019	Gemini telescope
13149	ZTF19abyukuy	Galactic nova	10/01/2019	Shane 3m Telescope, Lick Observatory
13153	ZTF19abxnerq	M31 nova	10/01/2019	Gemini telescope
13178	ZTF19abzpkss	dwarf nova	10/09/2019	Shane 3m Telescope, Lick Observatory
13183	ZTF19abydbvw	dwarf nova	10/11/2019	Shane 3m Telescope, Lick Observatory
13200	ZTF19acbwmqd	SN IIP	10/18/2019	Shane 3m Telescope, Lick Observatory
13210	ZTF19acbzgog	M31 nova	10/21/2019	Gemini telescope
13231	ZTF19acfsteg	M31 nova	10/28/2019	Gemini telescope
13261	AT2019tsc	M31 nova	11/04/2019	Gemini telescope
13286	ZTF19acmdpyr	SN Ia	11/12/2019	Shane 3m telescope, Lick Observatory
	ZTF19acklbjr	SN Ia	11/12/2019	Shane 3m telescope, Lick Observatory
13317	ZTF19acnfsij	M31 nova	11/28/2019	Shane 3m telescope, Lick Observatory
13358	ZTF19acxrihd	M31 nova	12/19/2019	Gemini telescope
13362	ZTF19acqprad	M31 nova	12/21/2019	Shane 3m telescope, Lick Observatory
13399	ZTF20aabbimu	dwarf nova	01/11/2020	Shane 3m telescope, Lick Observatory
13406	ZTF19acoqctv	SN IIP	01/15/2020	Shane 3m telescope, Lick Observatory
13430	ZTF20aakdppm	M31 nova	01/30/2020	Gemini telescope
13527	ZTF20aahpagw	SN IIn	02/27/2020	Shane 3m telescope, Lick Observatory
13570	ZTF19actabny	SN IIn	03/20/2020	Shane 3m telescope, Lick Observatory
13706	ZTF20aawbodq	Anomalous	05/03/2020	Anomaly filter by Soraisam et al. (2020)

ANTARES

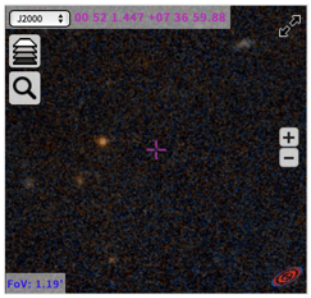
ANTARES beta | Streams | Favorites | Search | Filters | Pipeline | Watchlist | FAQ | Staff Tools | Logout (monika)

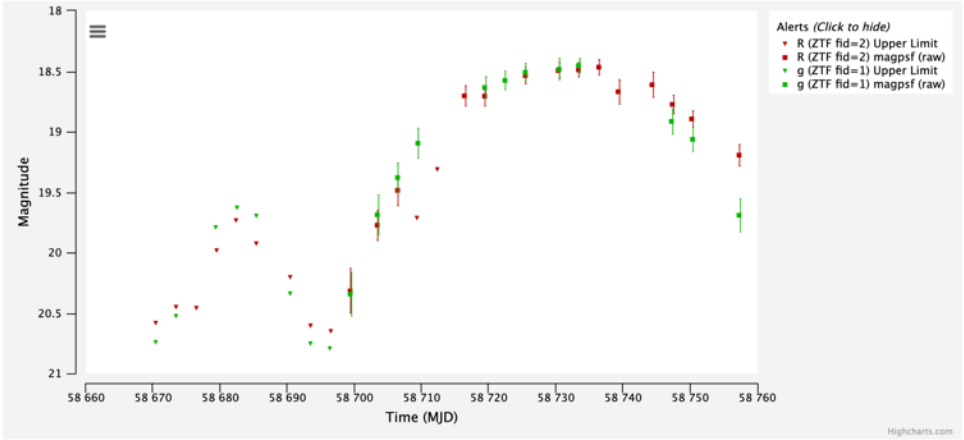
Locus 4360662

ICRS: *(ra)* 0h52m01.45s *(dec)* 7d36m59.88s
Galactic: *(l)* 123.187 *(b)* -55.2548
Ecliptic: *(λ)* 14.9193 *(β)* 1.88355

Num. Alerts: 45
ZTF Object ID: ZTF19abnacvf
Associated Streams:
refitt_newsources_snrcut, astrorapid_tde, nova_test
External Catalogs: SIMBAD, TNS, NED

Alerts
Finder Chart





Alert ID	RA	DEC	Ingest Time (UTC)	MJD
220562935	13.0061052	7.6165791	10/1/2019, 8:49:40 AM	58757.39755789982
220517027	13.0060662	7.6166007	10/1/2019, 7:58:54 AM	58757.3238309999
212979582	13.0060857	7.6165776	9/24/2019, 7:20:12 AM	58750.35964119993
212781436	13.0060727	7.6165957	9/24/2019, 6:23:52 AM	58750.31449070014
206012553	13.0060464	7.6165892	9/21/2019, 2:38:29 PM	58747.40013890015
205939865	13.0060713	7.6165954	9/21/2019, 1:34:28 PM	58747.316388899926
199885199	13.006054	7.6166034	9/18/2019, 8:34:50 AM	58744.380347200204
192757073	13.0060568	7.616611	9/13/2019, 5:23:00 AM	58739.37668980006
187814448	13.0060633	7.6165838	9/10/2019, 11:30:55 AM	58736.417986100074
187814500	13.0060796	7.6165864	9/10/2019, 11:30:57 AM	58733.44128469983

Show 10 entries
Showing 1 to 10 of 45 entries

« ‹ 1 2 3 4 5 › »

SN 2019nhs: SLSN-I

Astro Object Catalogs

ANTARES

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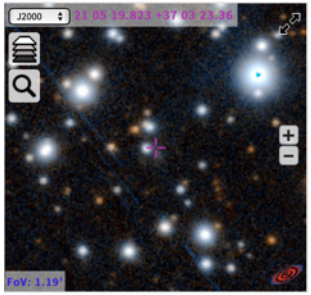
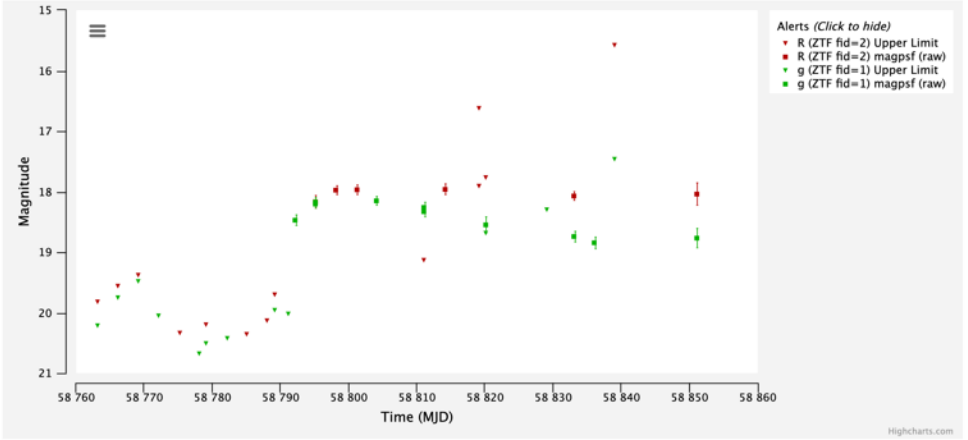
Locus 6335429

ICRS: *(ra)* 21h05m19.82s *(dec)* 37d03m23.36s
Galactic: *(l)* 80.8431 *(b)* -6.71653
Ecliptic: *(λ)* 335.27 *(β)* 50.54

Num. Alerts: 41
ZTF Object ID: ZTF19acoqctv
Associated Streams: refitt_newsources_snrcut, nova_test
External Catalogs: SIMBAD, TNS, NED

Alerts
Finder Chart





Alert ID	RA	DEC	Ingest Time (UTC)	MJD
376976533	316.3325078	37.0564258	1/2/2020, 11:48:14 PM	58851.11369210016
376909819	316.332559	37.0565852	1/2/2020, 9:34:28 PM	58851.09399309987
376909829	316.332559	37.0565852	1/2/2020, 9:34:28 PM	58839.11394680012
376909827	316.332559	37.0565852	1/2/2020, 9:34:28 PM	58839.07621529978
364217857	316.3325333	37.0564829	12/19/2019, 9:19:47 AM	58836.12116899993
360433884	316.3324727	37.0564587	12/16/2019, 9:31:30 AM	58833.11285880022
359525974	316.3325405	37.0564737	12/15/2019, 8:58:42 PM	58833.07629630016
359525990	316.3325405	37.0564737	12/15/2019, 8:58:42 PM	58829.096493099816
351551923	316.3326099	37.0565042	12/3/2019, 2:28:48 AM	58820.14342590002
351552053	316.3326099	37.0565042	12/3/2019, 2:28:51 AM	58820.13259259984

Show 10 entries
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AT 2019wed: SN-IIp

Astro Object Catalogs

ANTARES

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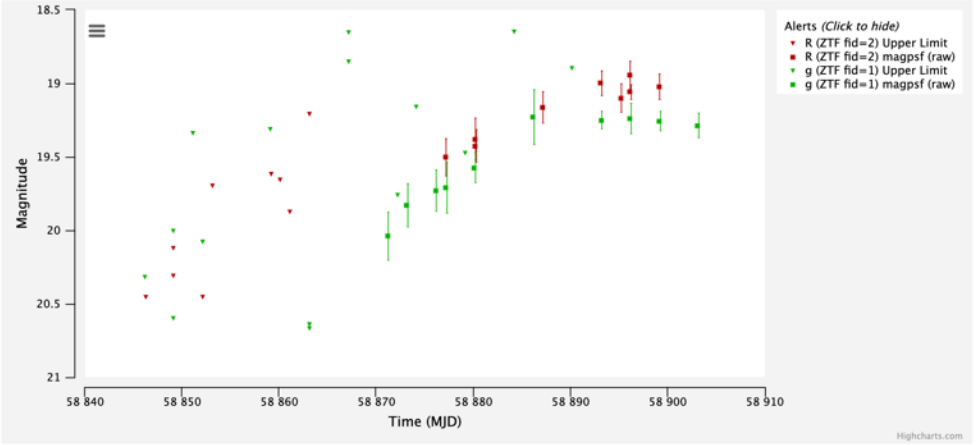
Locus 7916903

ICRS: *(ra)* 4h10m28.81s *(dec)* 34d06m46.03s
Galactic: *(l)* 163.317 *(b)* -12.7248
Ecliptic: *(λ)* 67.0099 *(β)* 12.8312

Num. Alerts: 43
ZTF Object ID: ZTF20aahapgw
Associated Streams:
refitt_newsources_snrcut, nova_test
External Catalogs: SIMBAD, TNS, NED

Alerts
Finder Chart



Alert ID	RA	DEC	Ingest Time (UTC)	MJD
453270788	62.6199637	34.1127671	2/24/2020, 12:25:41 PM	58903.13975689979
449129609	62.6199483	34.1127915	2/20/2020, 11:14:36 AM	58899.166261599865
448379888	62.619993	34.1127896	2/20/2020, 1:14:44 AM	58899.131446800195
446205480	62.619965	34.1127933	2/17/2020, 12:25:49 PM	58896.173819399904
445254252	62.6199901	34.1128019	2/17/2020, 12:25:47 AM	58896.13612269983
444957020	62.6200349	34.1127903	2/16/2020, 8:50:51 PM	58896.10240740003
444125064	62.6199601	34.1127586	2/16/2020, 8:02:36 AM	58895.186122700106
440516895	62.6199768	34.1127673	2/14/2020, 4:40:30 AM	58893.17826389987
440079417	62.6199888	34.1127844	2/13/2020, 11:10:00 PM	58893.14111110009
440079497	62.6199888	34.1127844	2/13/2020, 11:10:07 PM	58890.22613430023

Show 10 entries
Showing 1 to 10 of 43 entries

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AT 2020cnv: SN-IIn

Astro Object Catalogs

ANTARES

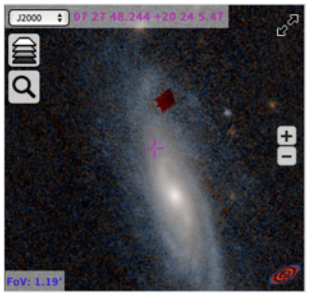
ANTARES beta | Streams | Favorites | Search | Filters | Pipeline | Watchlist | FAQ | Staff Tools | Logout (monika)

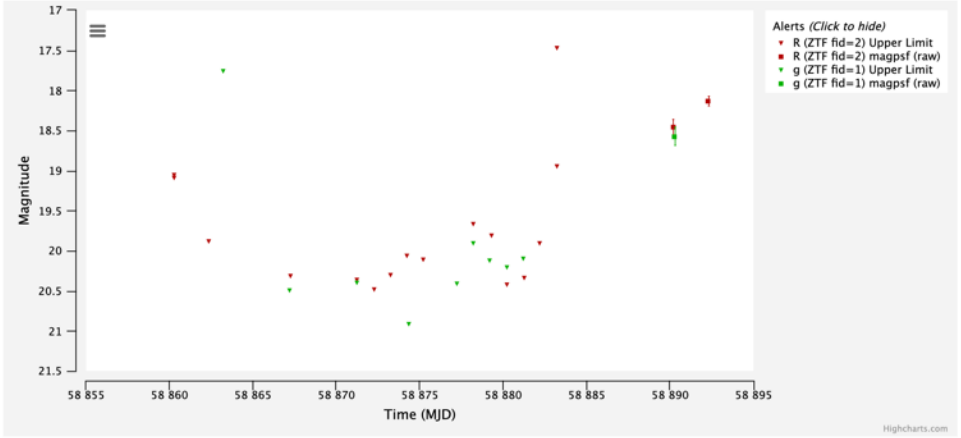
Locus 8492613

ICRS: *(ra)* 7h27m48.24s *(dec)* 20d24m05.47s
Galactic: *(l)* 198.237 *(b)* 16.9036
Ecliptic: *(λ)* 110.513 *(β)* -1.48939

Num. Alerts: 28
ZTF Object ID: ZTF20aammtwx
Associated Streams: extragalactic, young_extragalactic_candidate, yse_candidate_test, desi_candidate_test
External Catalogs: SIMBAD, TNS, NED

Alerts
Finder Chart





Alert ID	RA	DEC	Ingest Time (UTC)	MJD
439628971	111.9510437	20.4015318	2/13/2020, 10:31:02 AM	58892.28652779991
439629137	111.9510077	20.4014978	2/13/2020, 10:31:06 AM	58890.25298610004
435879952	111.9510152	20.4015203	2/11/2020, 2:41:19 AM	58890.172546300106
435880223	111.9510152	20.4015203	2/11/2020, 2:41:32 AM	58883.21247689985
435880202	111.9510152	20.4015203	2/11/2020, 2:41:32 AM	58883.18781250017
435880187	111.9510152	20.4015203	2/11/2020, 2:41:31 AM	58882.1540045999
435880175	111.9510152	20.4015203	2/11/2020, 2:41:31 AM	58881.27113430016
435880149	111.9510152	20.4015203	2/11/2020, 2:41:30 AM	58881.1917940001
435880121	111.9510152	20.4015203	2/11/2020, 2:41:29 AM	58880.232164400164
435880113	111.9510152	20.4015203	2/11/2020, 2:41:29 AM	58880.22552079987

Show 10 entries
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SN 2020cgu: SN-Ic

Astro Object Catalogs

ANTARES

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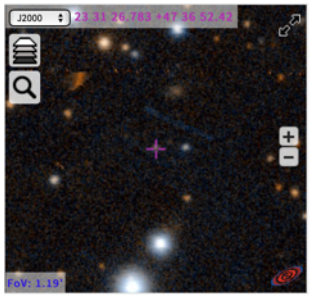
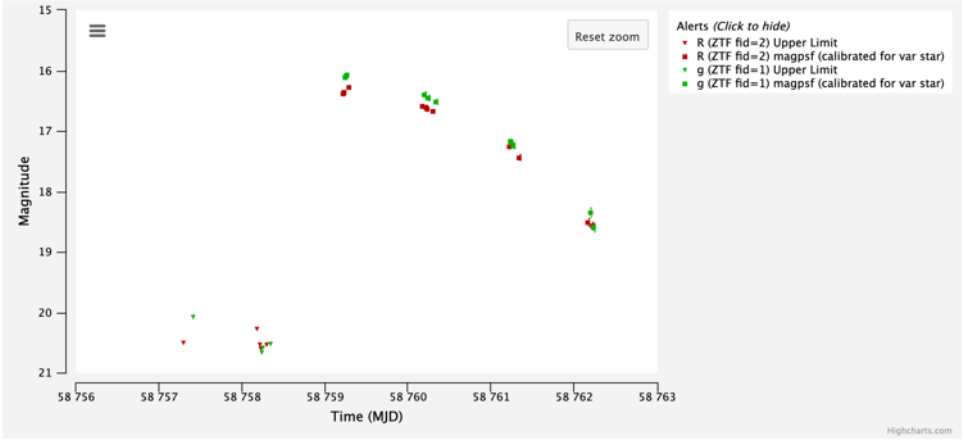
Locus 5824026

ICRS: *(ra)* 23h31m26.78s *(dec)* 47d36m52.42s
Galactic: *(l)* 109.239 *(b)* -13.1192
Ecliptic: *(λ)* 17.9679 *(β)* 45.3157

Num. Alerts: 169
ZTF Object ID: ZTF19abajklf
Associated Streams: anomaly_test, high_flux_ratio_wrt_nn
External Catalogs: SIMBAD, TNS, NED

Alerts
Finder Chart





Alert ID	RA	DEC	Ingest Time (UTC)	MJD
234857844	352.861593	47.6145312	10/6/2019, 3:06:18 PM	58762.242581000086
234859815	352.8615906	47.6145378	10/6/2019, 3:06:35 PM	58762.22989579989
233917048	352.8615978	47.6145804	10/6/2019, 12:14:50 PM	58762.22018520022
233175448	352.8616292	47.6145499	10/6/2019, 9:52:43 AM	58762.19945599977
232851961	352.8615987	47.6145724	10/6/2019, 8:20:27 AM	58762.171157400124
233919504	352.8615879	47.6145694	10/6/2019, 12:15:04 PM	58762.127488399856
233919489	352.861604	47.6145754	10/6/2019, 12:15:04 PM	58761.34138889983
233919468	352.861599	47.6145562	10/6/2019, 12:15:04 PM	58761.27118059993
233919445	352.8615948	47.6145493	10/6/2019, 12:15:03 PM	58761.249050899874
230314013	352.8615845	47.614559	10/5/2019, 4:37:49 PM	58761.23931710003

Show 10 entries
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Astro Object Catalogs

AT 2018eoh: Galactic CV

ANTARES Science

ZTF18abhjrcf: The First R Coronae Borealis Star from the Zwicky Transient Facility Public Survey

Chien-Hsiu Lee (李見修)[1], Thomas Matheson[1], Monika Soraisam[2,3], Gautham Narayan[3], Abhjita Saha[1], Carl Stubens[1], and Nicholas Wolf[1]

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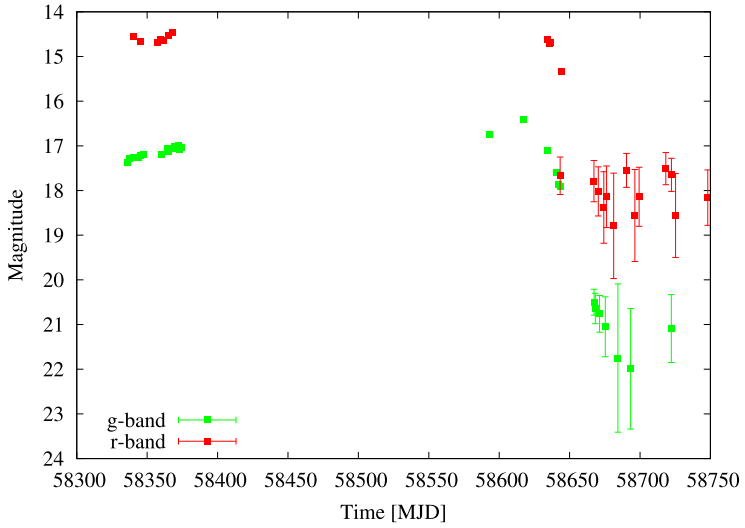
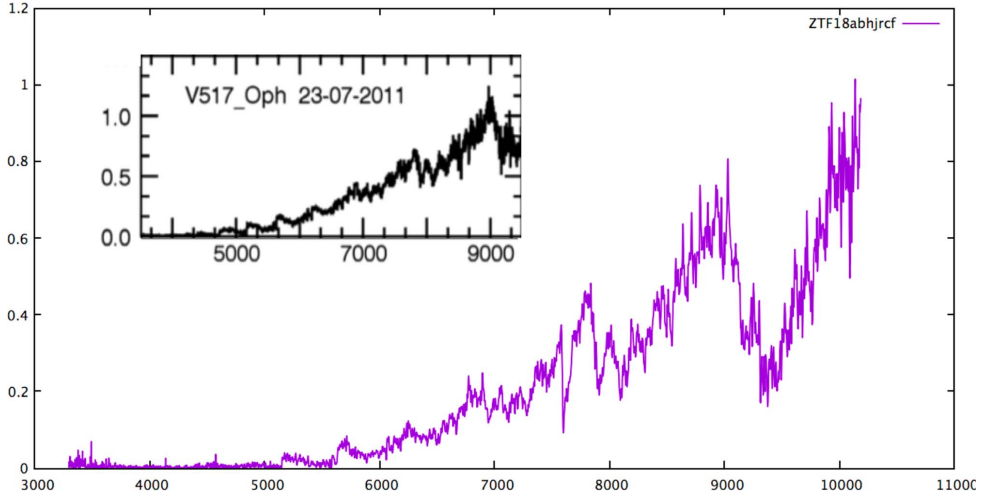
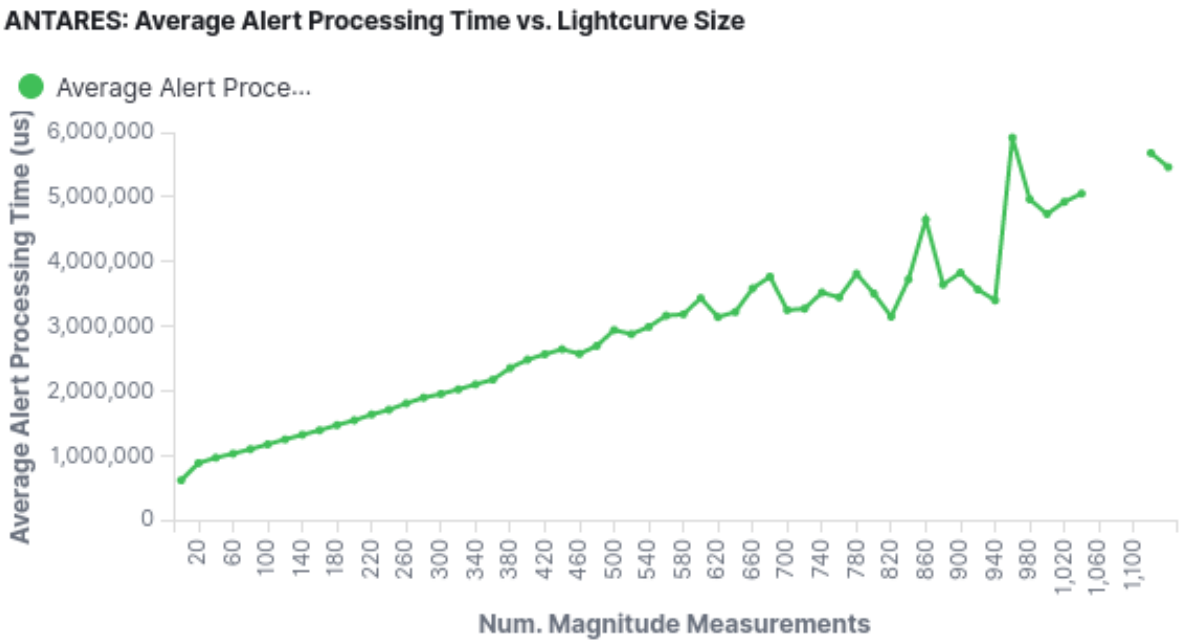
[2] National Center For Supercomputing Applications, USA
[3] University of Illinois At Urbana-Champaign, USA

Received 2019 November 15; revised 2019 November 20; accepted 2019 November 21; published 2020 January 21





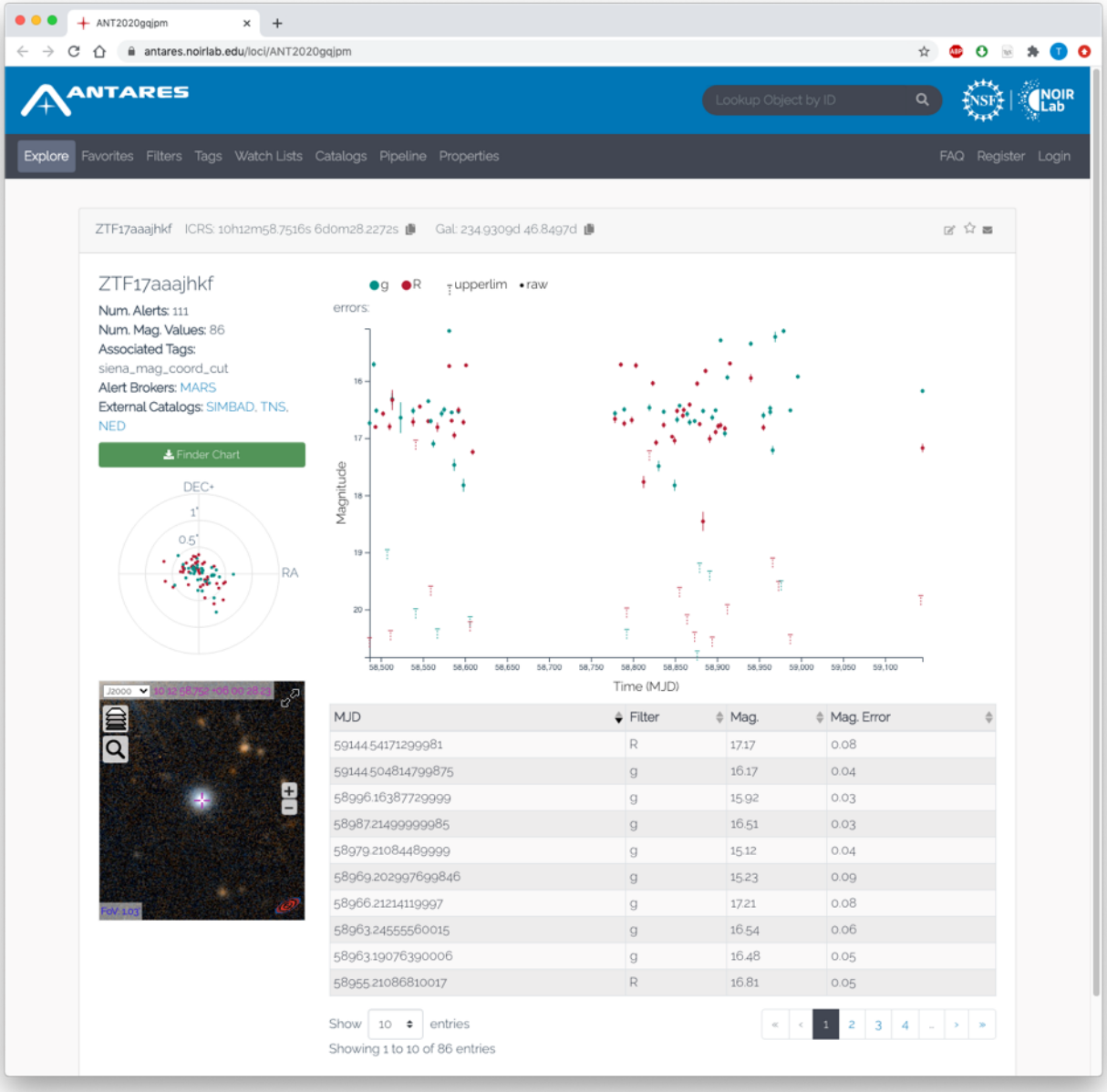
ANTARES Path to LSST



Load testing the system on Google Cloud Platform

Plenty of database and pipeline optimization to be done

Current, on-premise system can process 5.5 million alerts in 24 hours

The ANTARES technical solution can scale to LSST rate and volume

https://antares.noirlab.edu