ASAS SN Sky Patrol v2.0

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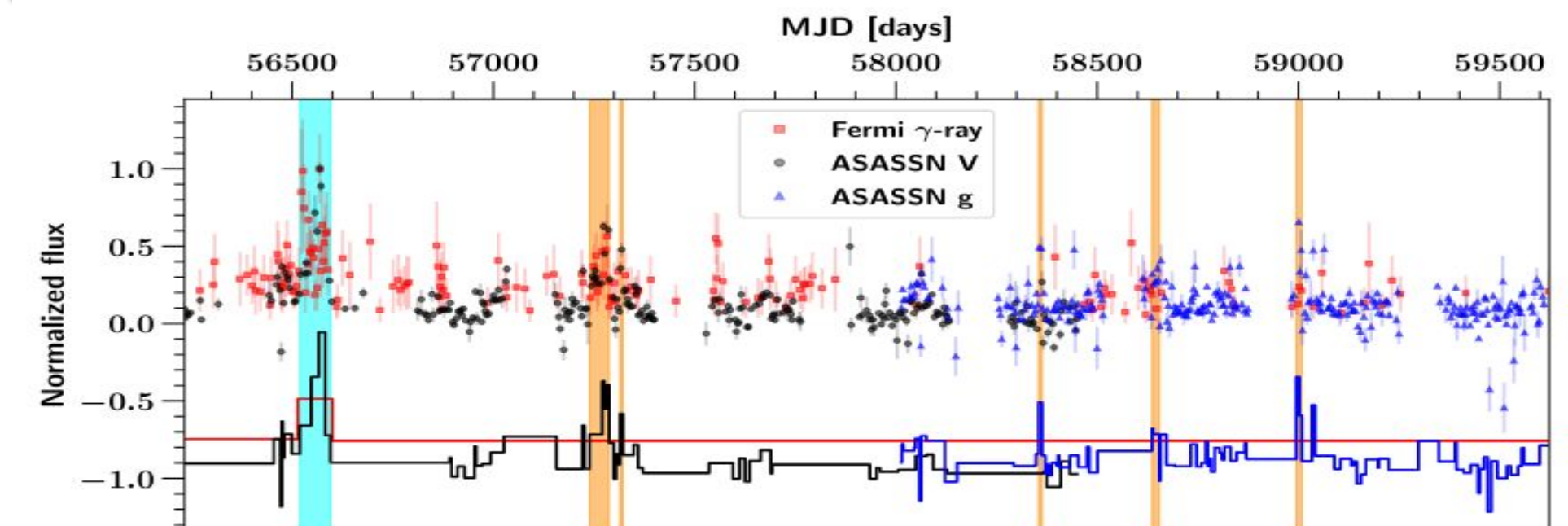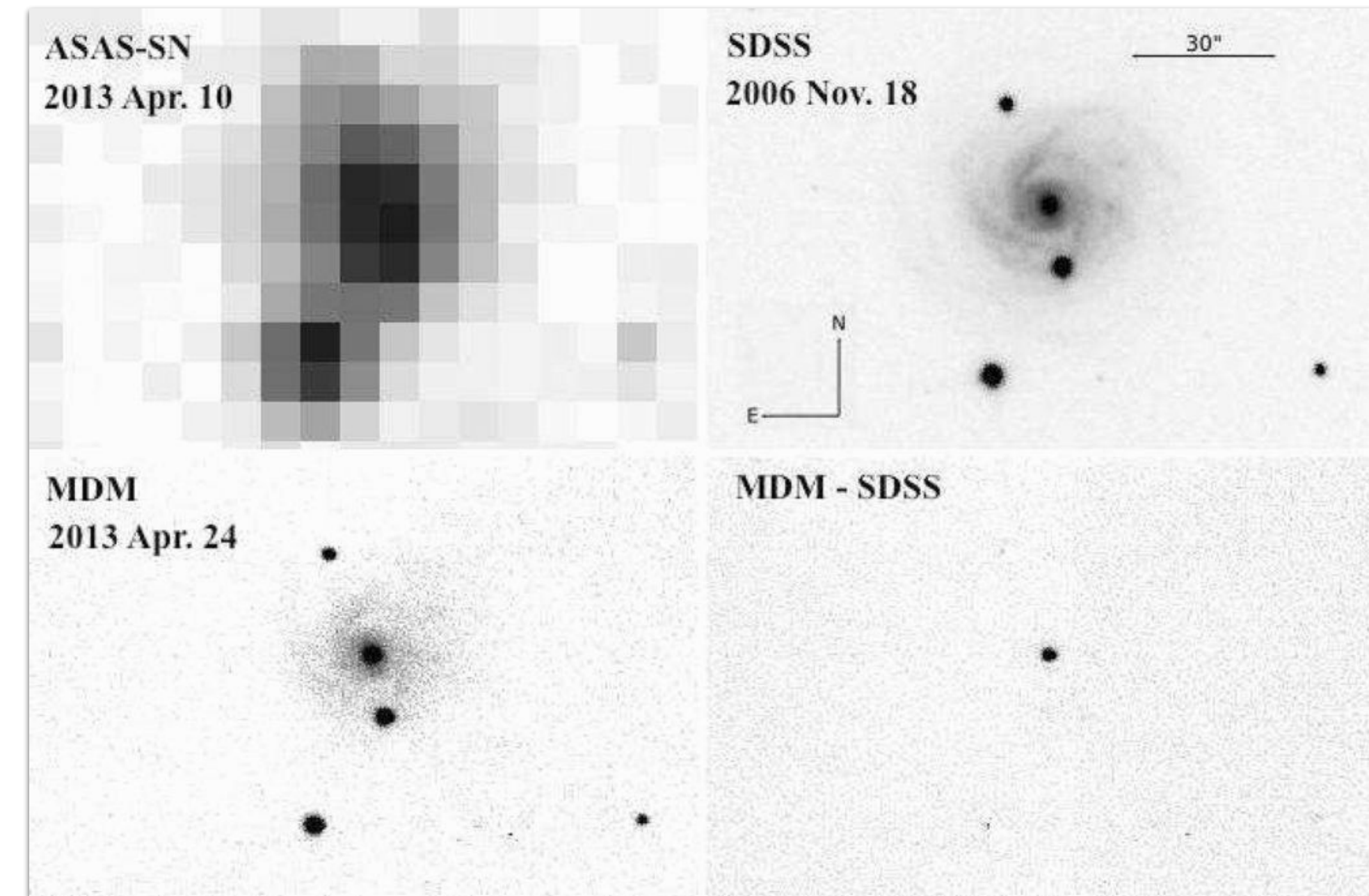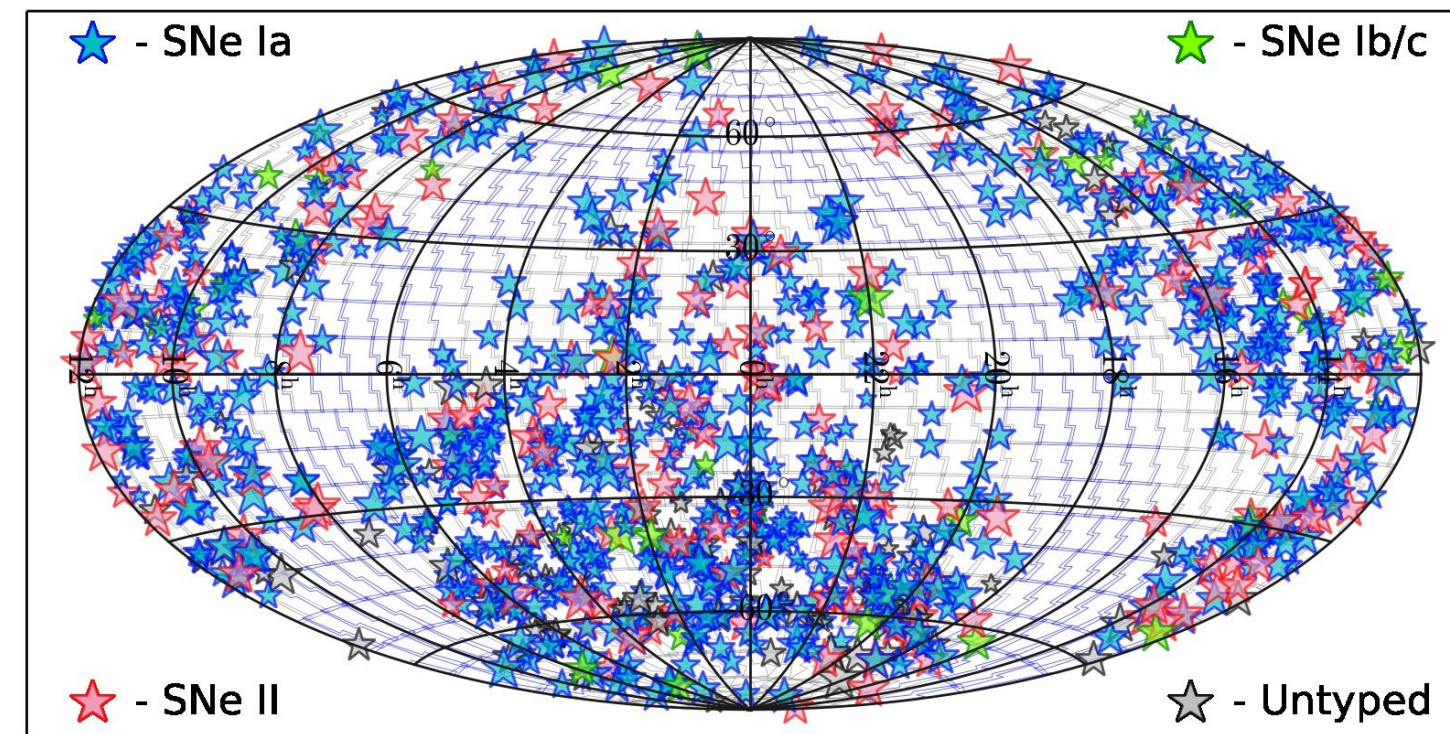
First light in 2011

- Discovers NGC 2617 (2013)

Current Discoveries
- Thousands of:
  - Supernovae
  - Cataclysmic Variables
  - M-dwarf flares
  - AGN, blazars
  - Microlensing events

Follow-ups
- Icecube
- LIGO/VIRGO

- SNe Ia
- SNe Ib/c
- SNe II
- Untyped

86.81 Days

ASAS-SN 2013 Apr. 10   SDSS 2006 Nov. 18   30"

MDM 2013 Apr. 24   MDM - SDSS

Cerro Tololo International Observatory (2014, 2017)

Haleakala Observatory (2011)

McDonald Observatory (2017)

South African Astronomical Observatory (2017)

Tian Shan Mountains (TBD)

Imaging

Aperture: 14-cm

Sensor: FLI Pro-Line 2K × 2K CCD
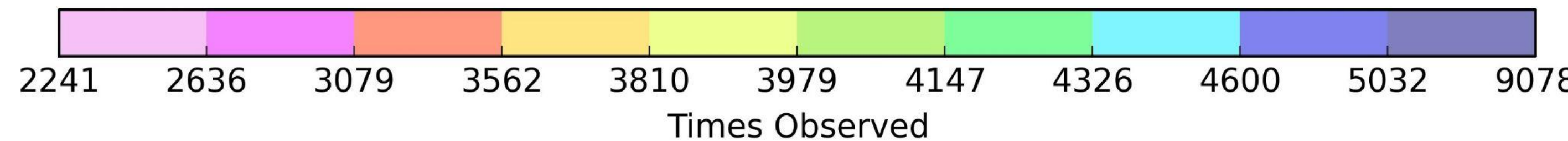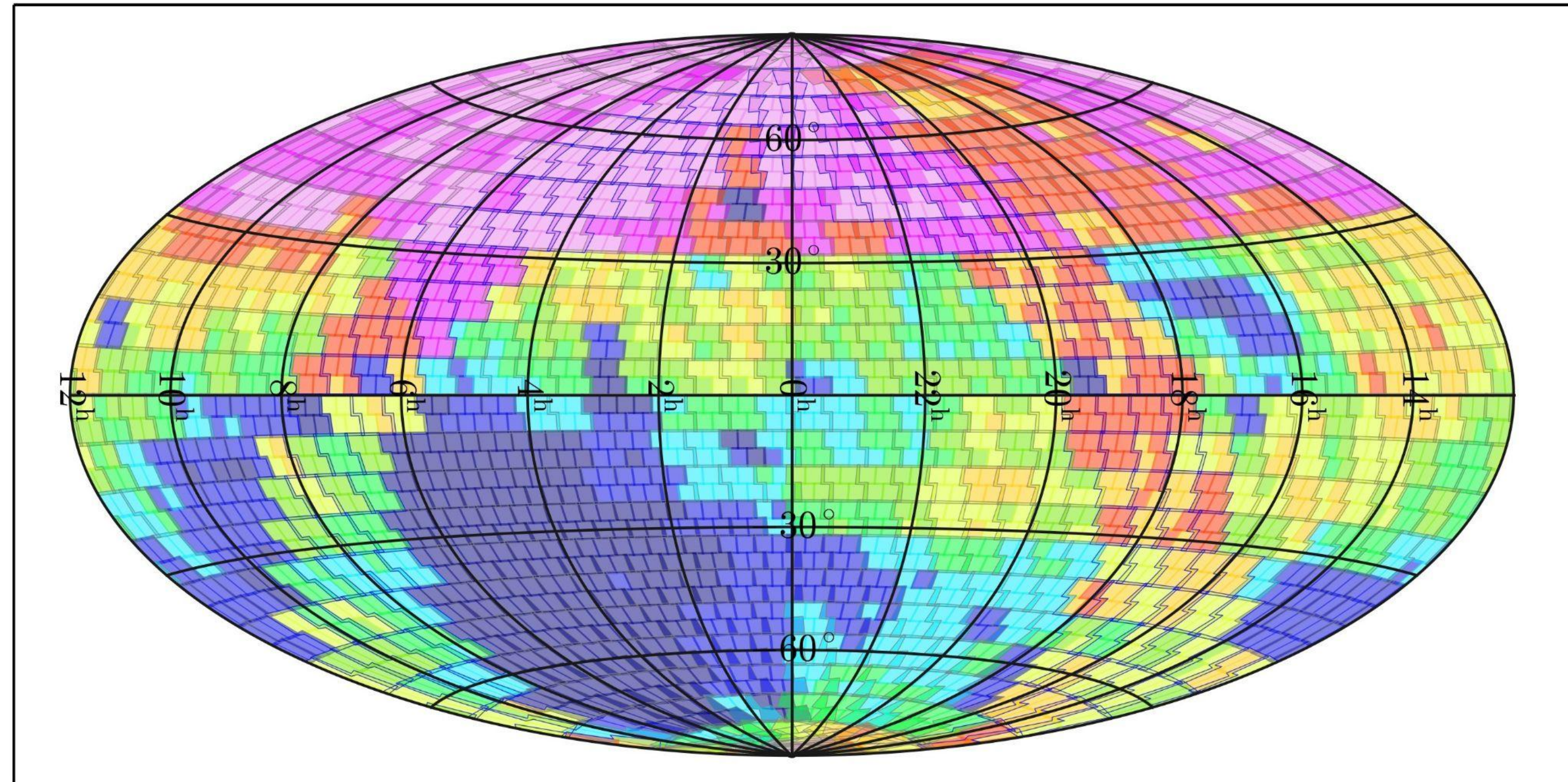
Cadence: nightly

Field Size: 4.5 x 4.5 *degrees*

Pixel Scale: 7.5 *arcsec*

Epoch: 3 dithered 90 second exposures*

Filter: g (current) V (legacy)

Limit: g - 18.5   V - 17.5

* Sometimes limited by weather and scheduling, average 2.7 images/epoch

20 Nov 2023 10:34.00

Times Observed

2241 2636 3079 3562 3810 3979 4147 4326 4600 5032 9078

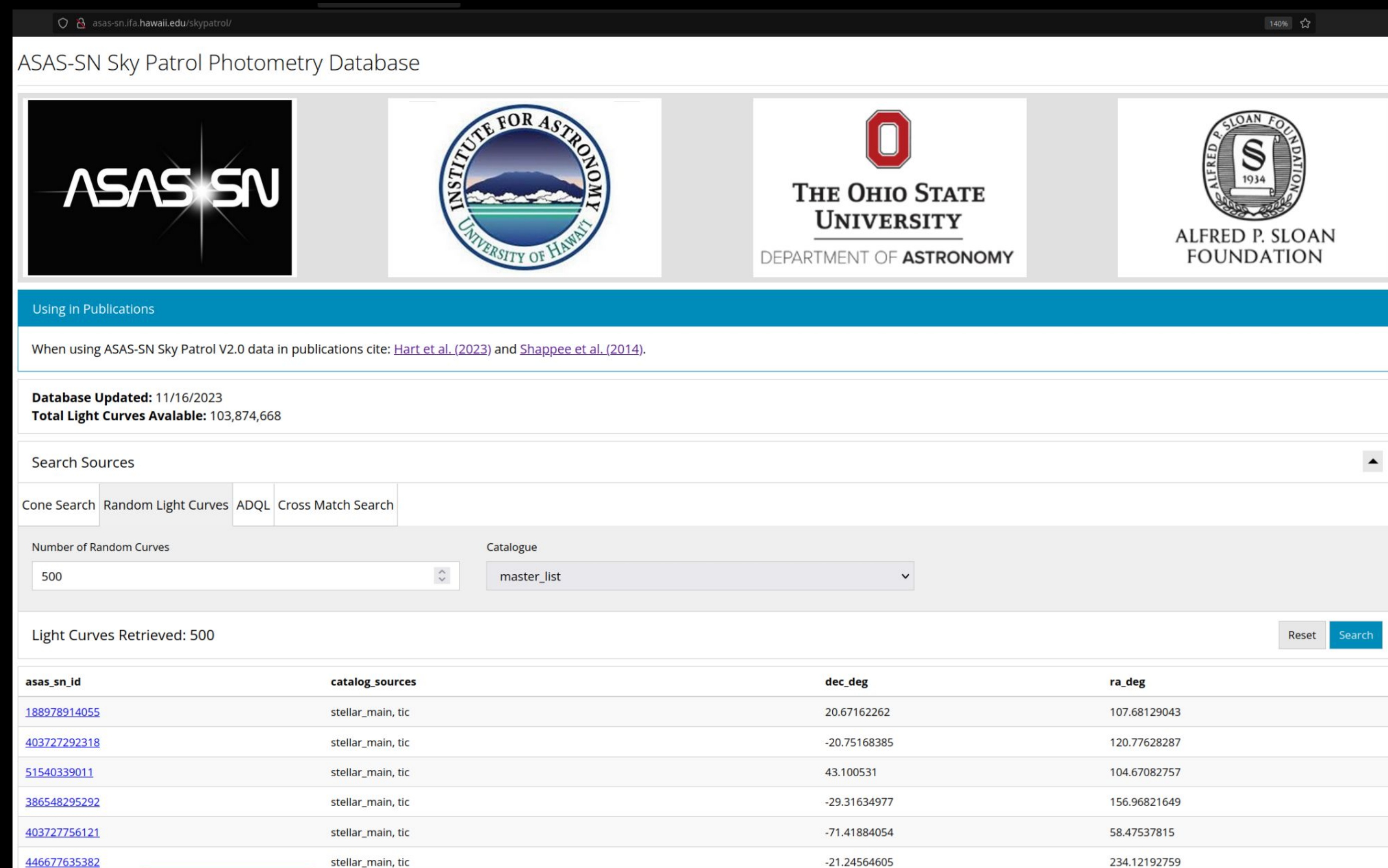- Forced photometry on data set.

- Optional reference flux subtraction.

- Automated checks for bad columns.

- Manual checks and flags for *bad images.*

- Aperture photometry runs on **IRAF**

- Delivered through **web interface.**

- Single light curves.

Field: F0017+18_0365   **Sources** 22,779

- Serve **pre-computed** light curves with **real-time** updates from our dataset.

- Include all sources within our limiting magnitudes as crowding allows.

- Provide website interface as well as interactive Python client.

- Allow for bulk queries (~ 100,000) of light curves on the order of minutes.

- Cross-match with existing catalog identifiers.

ASAS-SN Sky Patrol Photometry Database

Using in Publications

When using ASAS-SN Sky Patrol V2.0 data in publications cite: Hart et al. (2023) and Shappee et al. (2014).

Database Updated: 11/16/2023
Total Light Curves Avalable: 103,874,668

Search Sources

Cone Search | Random Light Curves | ADQL | Cross Match Search

Number of Random Curves
500

Catalogue
master_list

Light Curves Retrieved: 500

asas_sn_id	catalog_sources	dec_deg	ra_deg
188978914055	stellar_main, tic	20.67162262	107.68129043
403727292318	stellar_main, tic	-20.75168385	120.77628287
51540339011	stellar_main, tic	43.100531	104.67082757
386548295292	stellar_main, tic	-29.31634977	156.96821649
403727756121	stellar_main, tic	-71.41884054	58.47537815
446677635382	stellar_main, tic	-21.24564605	234.12192759

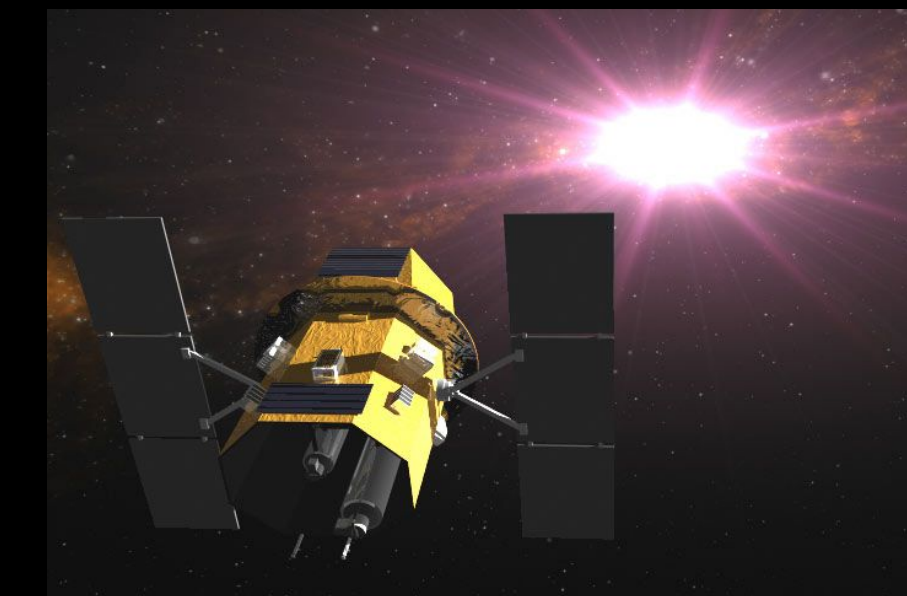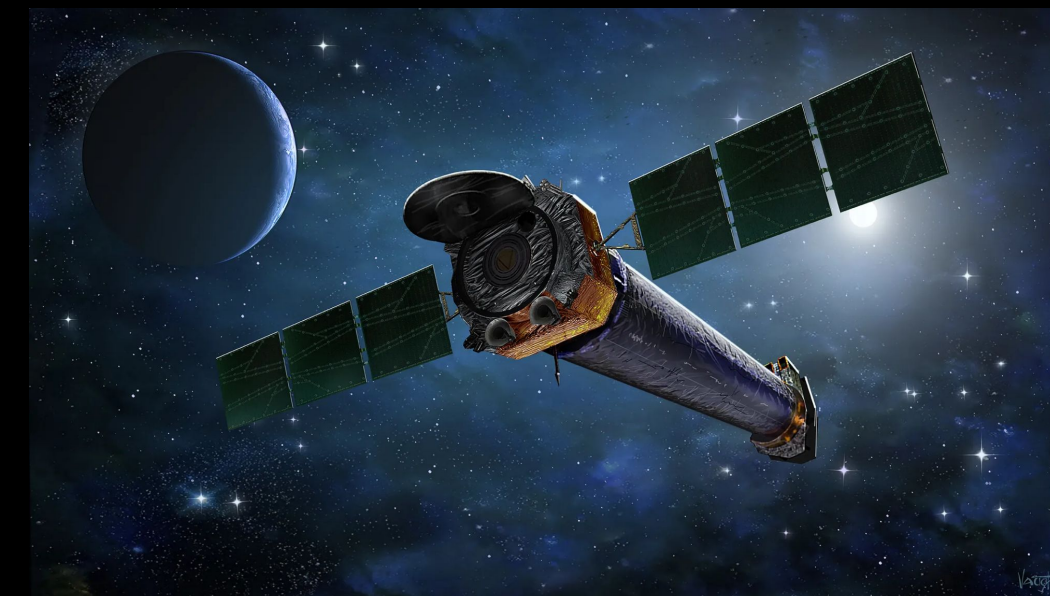**Base Stellar Source Table**

- Built from ATLAS Reference Catalog 2
  Magnitude: $g < 18.5$
  Crowding: r* > 20 arcsec

- Cross referenced to:
  Gaia DR2
  TESS Input Catalog V8.0

*Radius where cumulative G flux exceeds 1.0 x this star

Source Catalog	Type	n sources
ASAS-SN Stellar Source Table	Stellar	98,602,587
Fermi LAT 10-Year Point Sources	Gamma Ray	5,788
Chandra Sources v2.0	X-Ray	317,224
Swift Master Catalog	Optical/UV/X-Ray/Gamma Ray	254,936
AllWISE AGN Catalog	Mid-IR/AGN	1,354,775
Million Optical/Radio/X-Ray Associations Catalog (MORX)	Optical/Radio/X-Ray	3,262,883
Million Quasars Catalog (MILLIQUAS)	QSO	1,979,676
Bright M-Dwarf All Sky Catalog	Stellar	8,927
AAVSO International Variable Star Index	Stellar	1,437,528
Galaxy List for the Advanced Detector Era (GLADE)	Galaxy	3,263,611

External Catalogs

- Cross matched on pixel scale, includes:

- NASA HEASARC Source Catalogs

- GLADE Galaxy Catalog

- Solar System Sources

- … and more?

Lookup Tools

Cone Search
- Fast cone searches of arbitrary size.
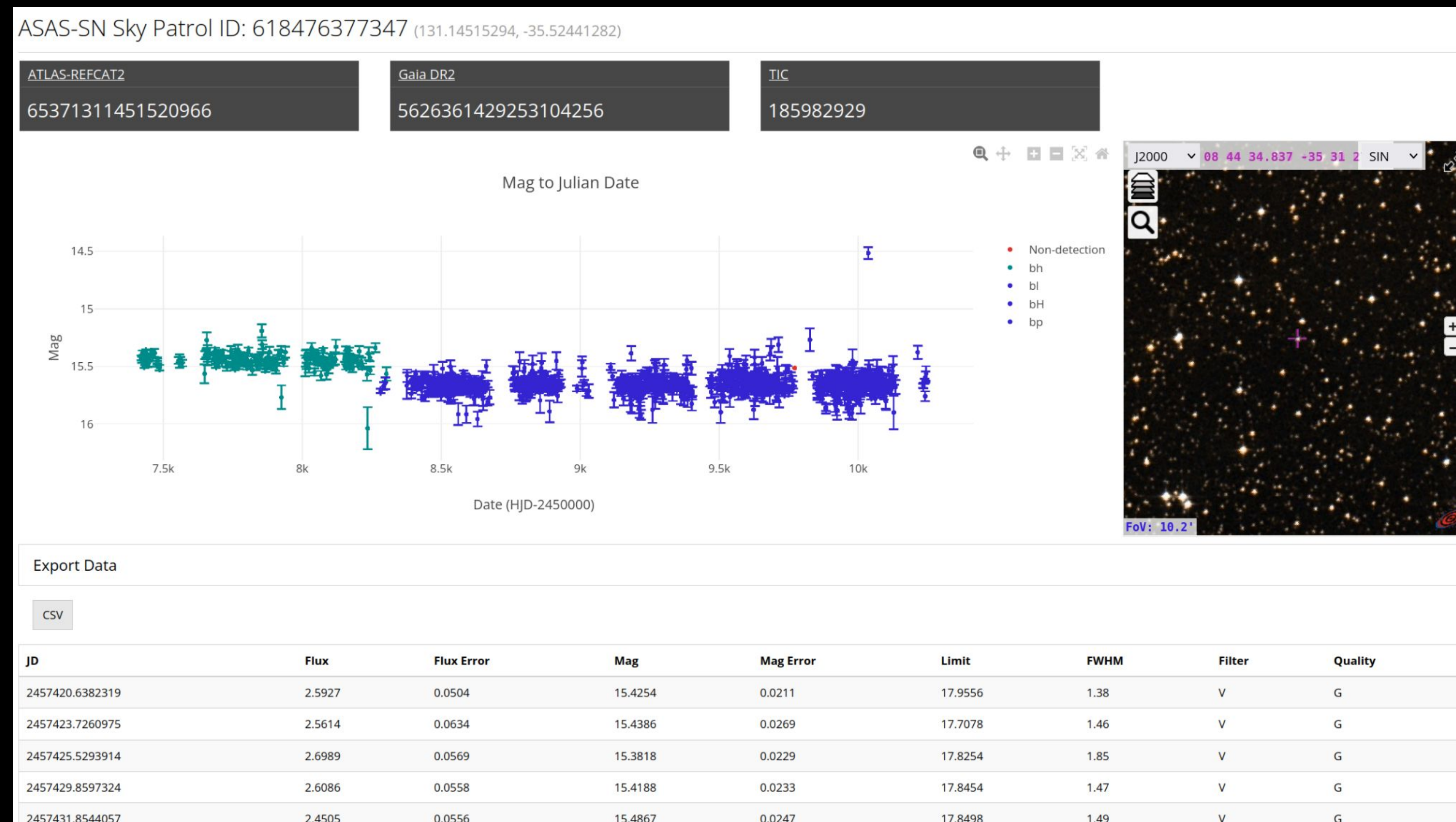
Random Selection
- Useful for testing and data science.

Astronomical Data Query Language (ADQL)
- Similar to Gaia Archive or VizieR interface.
- Allows for cross-catalog matching.
- Complex parameter searches.

Direct Catalog Lookup
- Batch query targets based on external catalog IDs (Gaia, SDSS, AllWISE, etc.)

ASAS-SN Sky Patrol ID: 618476377347 (131.14515294, -35.52441282)

ATLAS-REFCAT2	Gaia DR2	TIC
65371311451520966	5626361429253104256	185982929

Mag to Julian Date

- Non-detection
- bh
- bl
- bH
- bp

Date (HJD-2450000)

Export Data

CSV

JD	Flux	Flux Error	Mag	Mag Error	Limit	FWHM	Filter	Quality
2457420.6382319	2.5927	0.0504	15.4254	0.0211	17.9556	1.38	V	G
2457423.7260975	2.5614	0.0634	15.4386	0.0269	17.7078	1.46	V	G
2457425.5293914	2.6989	0.0569	15.3818	0.0229	17.8254	1.85	V	G
2457429.8597324	2.6086	0.0558	15.4188	0.0233	17.8454	1.47	V	G
2457431.8544057	2.4505	0.0556	15.4867	0.0247	17.8498	1.49	V	G

Search Examples

HEASARC Catalogs

The remaining catalogs were sourced from NAS[...]
asas_sn_id for all of them.

```
client.catalogs.aavsovsx.head(12)
```

	col_names	dtypes
0	asas_sn_id	bigint
1	ra_deg	double
2	dec_deg	double
3	source_number	bigint
4	name	string
5	variability_flag	bigint
6	lii	double
7	bii	double
8	variability_type	string
9	max_mag_type	double
10	max_mag_limit	string
11	max_mag	double

ADQL Queries

We have inculded a custom ADQL parser. That will allow users to query targ[...]
perform a cone-search.

```
query = """
SELECT
 *
FROM stellar_main
WHERE DISTANCE(ra_deg, dec_deg, 270, 88) <= ARCMIN(7.1)
"""

client.adql_query(query)
```

JOINS

Since we have cross matched all of our catalo[...]

```
query = """
SELECT
 asas_sn_id,
 chandra.name AS c_name,
 fermi.name
FROM chandra
JOIN fermi USING(asas_sn_id)
"""

client.adql_query(query)
```

Complex Searches

Lets say we were searching for white dwarfs that crossmatched in the VSC[...]

```
query = """
SELECT
  asas_sn_id,
  gaia_id,
  pstarrs_g_mag,
  (gaia_mag - (5 * LOG10(plx) - 10)) AS g_mag_abs,
  name
FROM stellar_main
JOIN aavsovsx USING(asas_sn_id)
WHERE 1=1
 AND pstarrs_g_mag < 14
 AND (gaia_mag - (5 * LOG10(plx) - 10)) > 10
 AND (gaia_b_mag - gaia_r_mag) < 1.5
"""

client.adql_query(query)
```
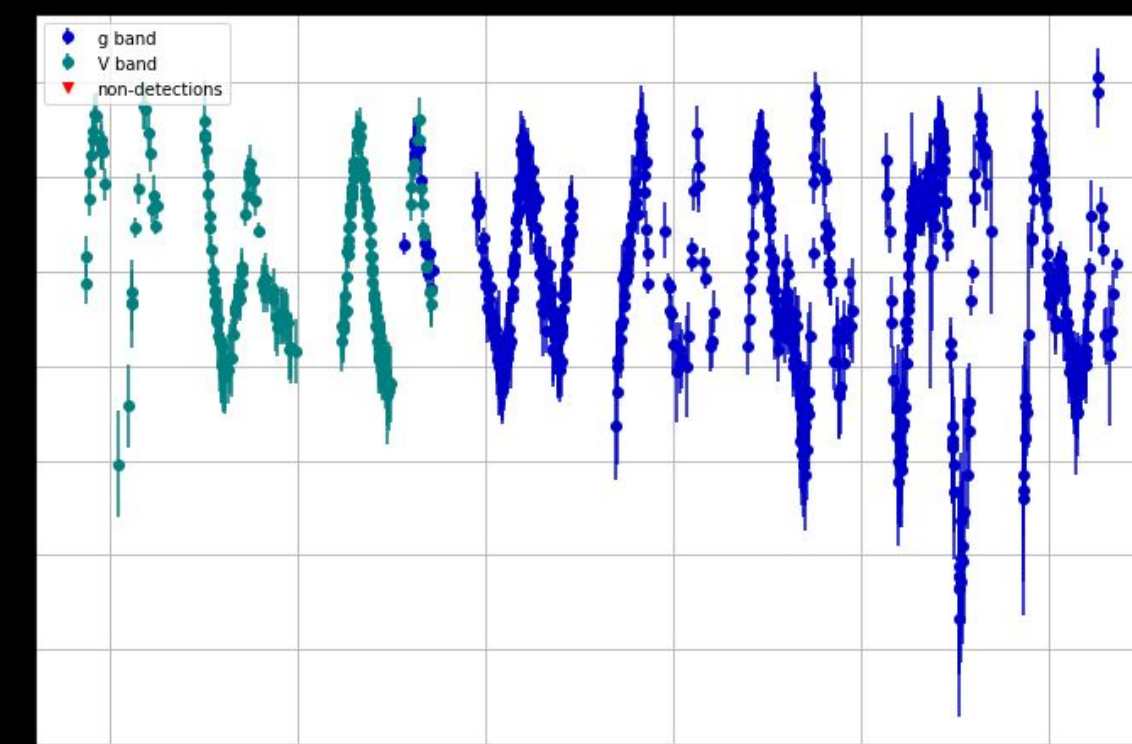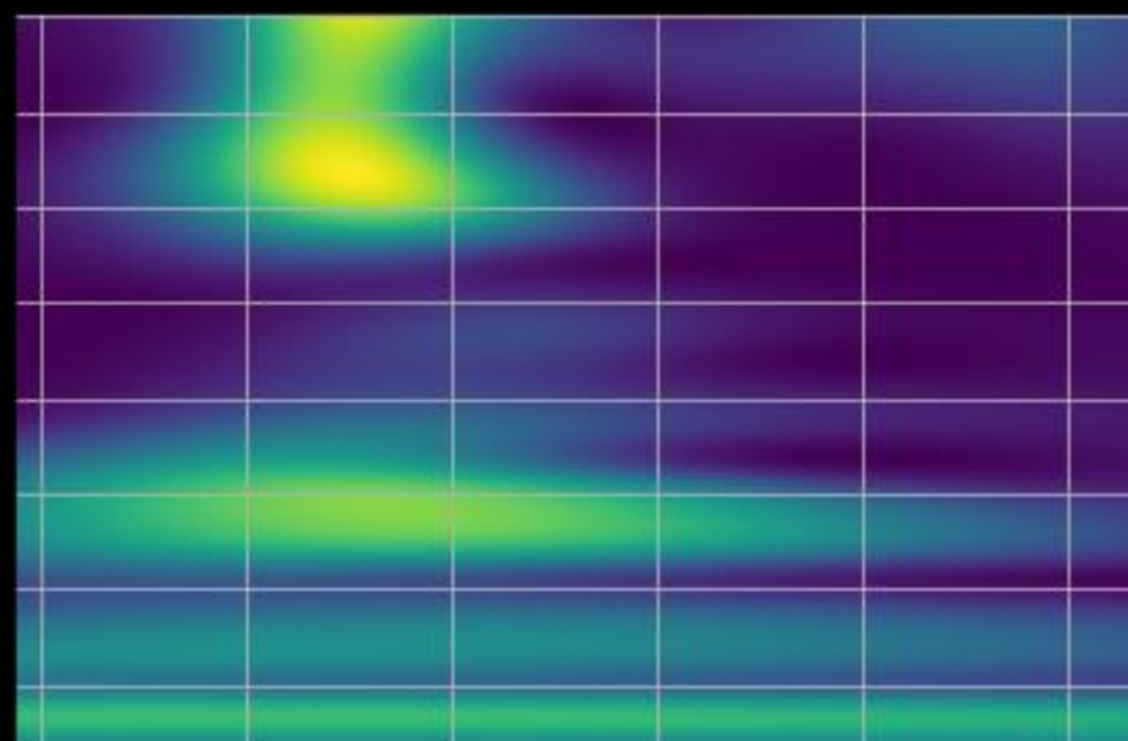
Processing and Analysis for Light Curves

- Lomb-scargle periodogram
- Phase folding
- Normalization
- Wavelet transforms
- Anomaly Removal
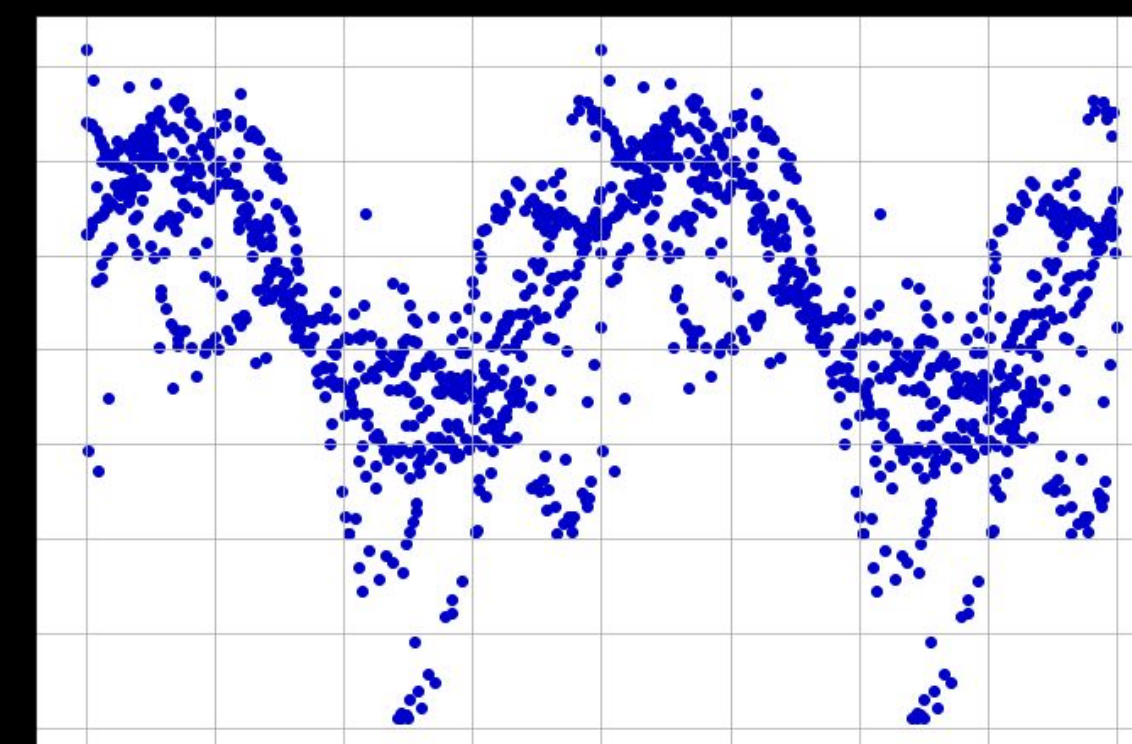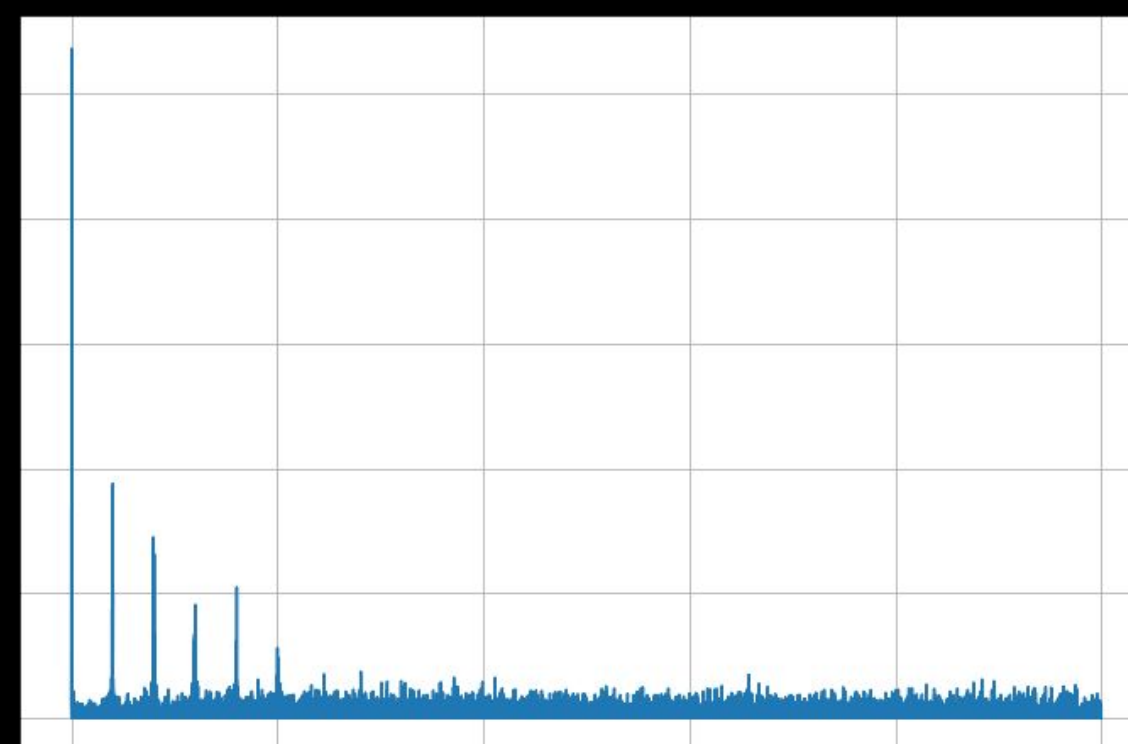
Moving Forward...
- Github collaboration
- Citation generation
- Plug into User Patrols...

Object Patrols

- Specialized target sets (AGN, YSO, etc.)
- Multi-channel alert distribution.
- Correlate with other available datasets (TESS, ATLAS, more...)
- Advanced triggers.

User Patrols
- Sky Patrol API Integration.
- Arbitrary target sets.
- Arbitrary triggering functions.
- User input?