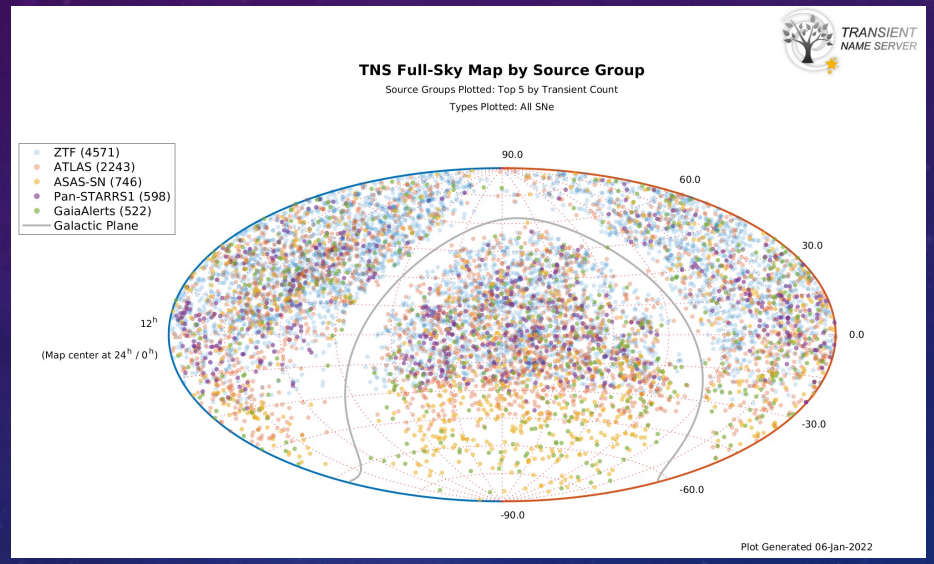
The **Transient Name Server**

in light of the MMA realm

[Overview for the Paris MMA workshop - Jan 2022]

Ofer Yaron

- Name server
- Fully searchable
- Citable (ADS indexed)



The Official IAU transient reporting mechanism

Reports

- "Manual" [forms] (including amateurs)
- Automatic [bots] (most surveys)
- Brokers

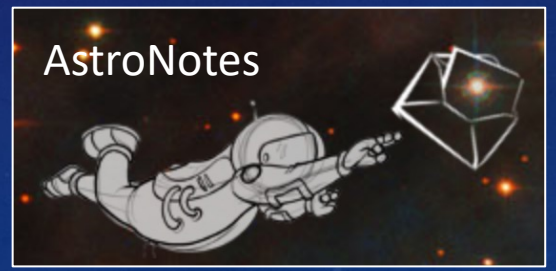
Alerts on

Transients (AT)

Classifications (SN...)

FRBs

(GRBs, GW events ...)



The team: Avishay Gal-Yam (PI, chair of IAU SN WG),

Avner Sass, Eran Ofek, Nikola Knezevic

Weizmann Institute for Science

www.wis-tns.org

The Transient Name Server - overview

- In operation since Jan 1st, 2016. The official IAU mechanism for reporting new astronomical (extra galactic) transients and specifically for official name designation. (Set up by the IAU in order to provide a modern, automatic mechanism to archive and distribute alerts about transients, replacing the manual CBAT system.)

- [As of Jan 2022] holds: ~90k reported transient candidates ("ATs"),
  >9k (10%) classified SNe (in addition the full catalog of all pre-2016 SNe),
  >1k registered users, >120 groups

- The basic TNS object is an Astronomical Transient (AT) with a unique identifier of the form AT YYYYx (x=A..Z, aa..zz, aaa..zzz,…). The prefix "AT" can be later changed to indicate a classification (e.g., "SN") but the unique identifier is always kept.

- Most reports are submitted automatically by "bots" of the major surveys & brokers (PS1, ZTF, Gaia, ATLAS…), but it is also possible to submit reports interactively using forms. Discovery reports are called *AT-reps* whereas classification reports (supported by a spectrum, for the "normal" transients) are called *Class-reps*.

- The system naturally handles multiple reports on the same event (e.g., discoveries of the same object by different surveys) and keeps a (fully searchable) record of "internal names" that are associated with each AT-rep.

- The system supports a service for short astronomical announcements (AstroNotes) which is a superior version of the ATEL system (e.g., searchable; hyperlinked to the specific objects).

The Transient Name Server - overview

- All reports and AstroNotes are indexed by the ADS and are citable.
- Currently all alerts/notifications from the TNS (discoveries/classifications/AstroNotes) are distributed via emails to the registered users, according to their defined preferences. (Additional staging/alerting mechanisms (e.g. Kafka streams) may be added.)
- Some data can be reported as proprietary for a certain period of time; e.g. securing a name designation without official release of the details yet, or not exposing a classification spectrum.
- Groups, Bots and memberships are all self-managed (by the users/group-owners), thus enabling flexible handling of access permissions, controlling the discovery credits etc.
- The system resides on the AWS cloud, increasing its high-availability capacity and scalability.
- On Mar 2020 the Fast Radio Bursts (FRB) community joined the TNS.
    - An additional subsystem was tailored for handling the specific requirements of FRBs – including a separate naming engine (FRB YYYYMMDDx), a separate report form (for the specific FRB properties), and enabling specification of area localizations (*"area transients"*).
- Adaptations for the Gamma-Ray Bursts (GRB) community are now in design phase.
  (Requiring a separate GRB naming engine, and several additional challenges, e.g. the editing of many properties after the initial report…)

Two major requirements/guidelines of the TNS

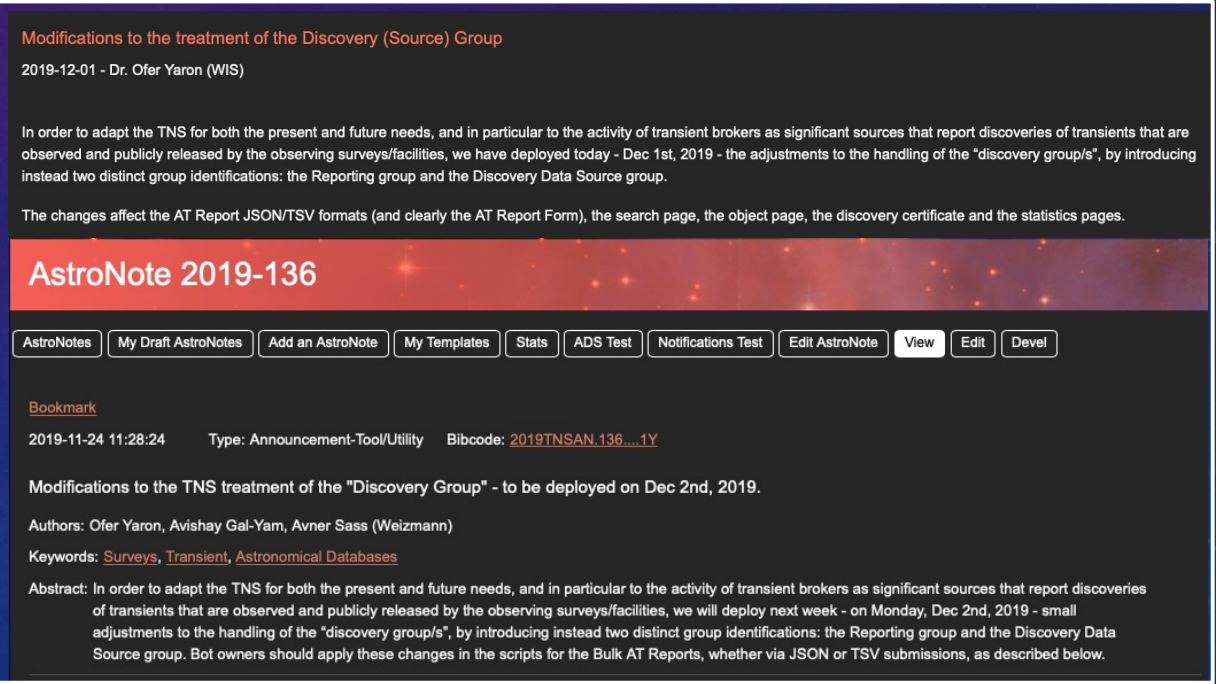
- To provide quick (low-latency) and robust processing of the incoming reports, and in strict order of arrival.
  - No downtime is allowed (downtimes are kept on the level of a few hours per year).
  - A high-availability and scalable system configuration is provided.
- The TNS is dynamic - constantly adapted to meet the needs of the community and its working protocols, as well as the inclusion of new communities and system components.

e.g. with the emergence of “brokers”,
the need to split the “Source group” to the

- Reporting group

and the

- Discovery data source group.



Modifications to the treatment of the Discovery (Source) Group

2019-12-01 - Dr. Ofer Yaron (WIS)

In order to adapt the TNS for both the present and future needs, and in particular to the activity of transient brokers as significant sources that report discoveries of transients that are observed and publicly released by the observing surveys/facilities, we have deployed today - Dec 1st, 2019 - the adjustments to the handling of the “discovery group/s”, by introducing instead two distinct group identifications: the Reporting group and the Discovery Data Source group.

The changes affect the AT Report JSON/TSV formats (and clearly the AT Report Form), the search page, the object page, the discovery certificate and the statistics pages.

AstroNote 2019-136

AstroNotes | My Draft AstroNotes | Add an AstroNote | My Templates | Stats | ADS Test | Notifications Test | Edit AstroNote | View | Edit | Devel

Bookmark

2019-11-24 11:28:24 Type: Announcement-Tool/Utility Bibcode: 2019TNSAN.136....1Y

Modifications to the TNS treatment of the "Discovery Group" - to be deployed on Dec 2nd, 2019.

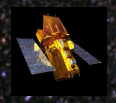
Authors: Ofer Yaron, Avishay Gal-Yam, Avner Sass (Weizmann)

Keywords: Surveys, Transient, Astronomical Databases

Abstract: In order to adapt the TNS for both the present and future needs, and in particular to the activity of transient brokers as significant sources that report discoveries of transients that are observed and publicly released by the observing surveys/facilities, we will deploy next week - on Monday, Dec 2nd, 2019 - small adjustments to the handling of the "discovery group/s", by introducing instead two distinct group identifications: the Reporting group and the Discovery Data Source group. Bot owners should apply these changes in the scripts for the Bulk AT Reports, whether via JSON or TSV submissions, as described below.

UV/visible/IR surveys





Real-time transient Alerts since 2016

Radio surveys

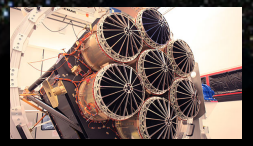
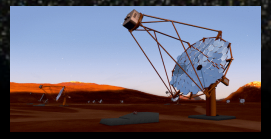

Joined 2020

Discussion initiated

Gravitational Wave Detectors


Potential

High energy surveys (X/γ)

TRANSIENT NAME SERVER

All data

WISeREP

Robotic follow-up facilities

Major follow-up collaborations

Pessto ESO

LCO Las Cumbres Observatory

NASA data system

astrophysics data system

Data queries

Data contributions

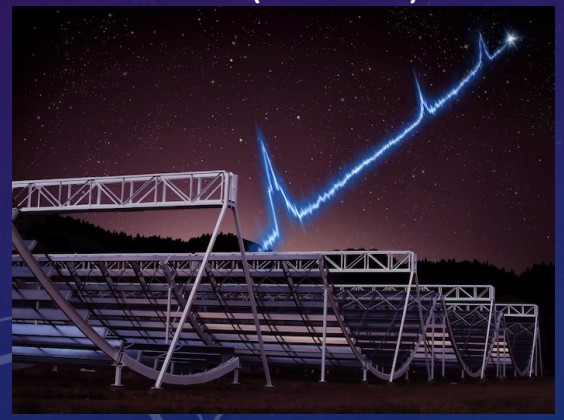
Global Astrophysics Community

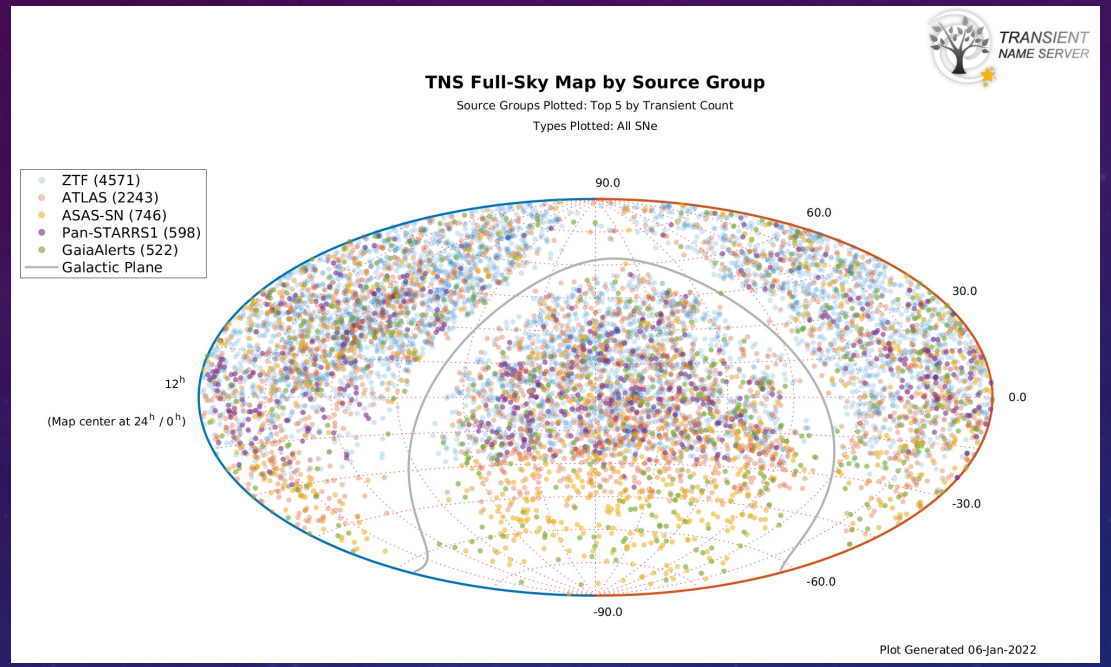
Some of the major surveys reporting to the TNS

Pan-Starrs (Hawaii)

ZTF, iPTF (Palomar, CA)

CHIME-FRB (Canada)



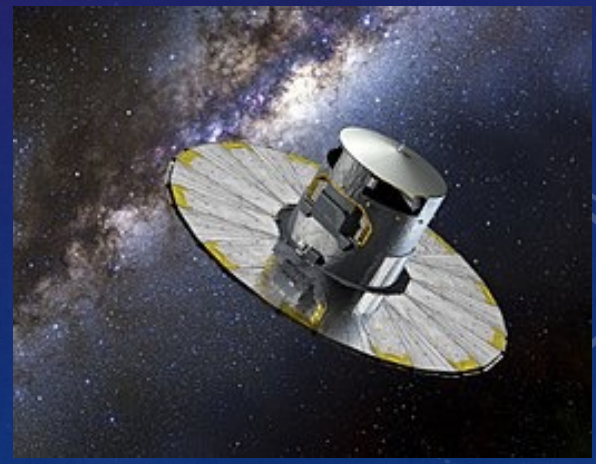


Soon…

- GRBs
- LIGO-Virgo-KAGRA ?

ATLAS (Hawaii)

Gaia (Space)



www.wis-tns.org/stats-maps

TNS Statistics (as of 2022-01-10)

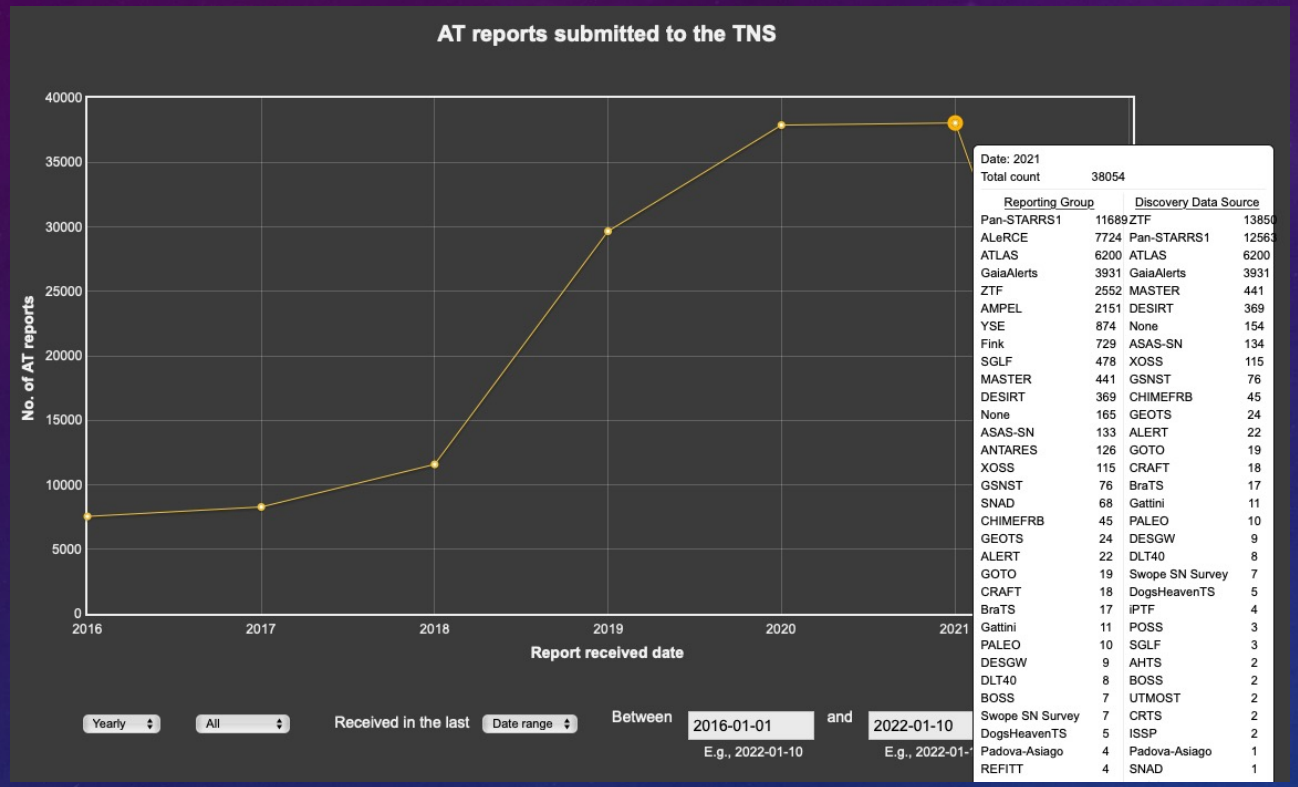
ALL transients reported since Jan 1, 2016	88495	
PUBLIC transients reported since Jan 1, 2016	88413	
PUBLIC transients for the top 5 reporting groups	Pan-STARRS1	26791
	GaiaAlerts	14205
	ZTF	12941
	ALeRCE	12712
	ATLAS	10352
PUBLIC transients for the top 5 data source groups	Pan-STARRS1	28307
	ZTF	28064
	GaiaAlerts	14205
	ATLAS	10352
	iPTF	1636
PUBLIC classified SNe reported since Jan 1, 2016	9465	
PUBLIC classified SNe for the top 5 reporting groups	ZTF	2699
	ATLAS	2275
	ALeRCE	1622
	ASAS-SN	754
	GaiaAlerts	528
PUBLIC classified SNe for the top 5 data source groups	ZTF	4583
	ATLAS	2275
	ASAS-SN	753
	Pan-STARRS1	603
	GaiaAlerts	528
ALL spectra reported to the TNS	11606	
PUBLIC spectra reported to the TNS	11307	
PUBLIC classifications for the top 5 contributing groups	ZTF	4477
	ePESSTO+	990
	ePESSTO	723
	SCAT	679
	PESSTO	277

PUBLIC classified SNe by type

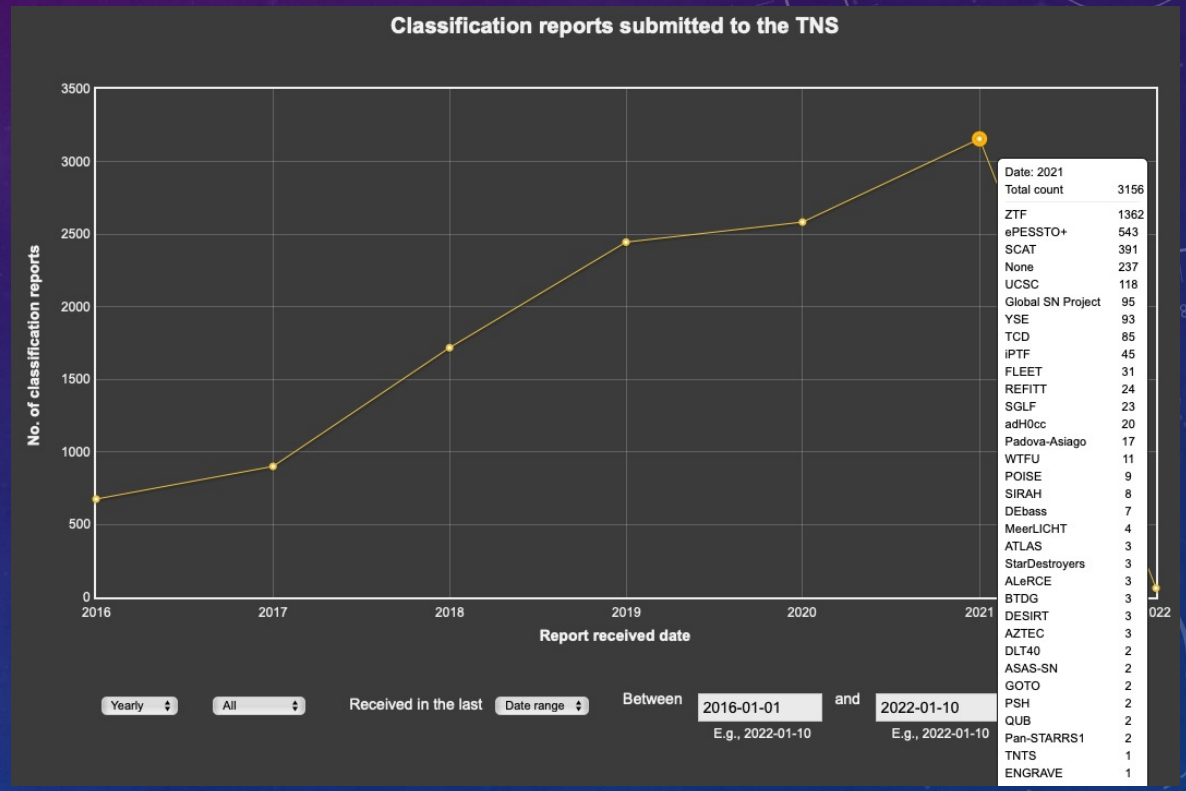
SN Ia	6208
SN II	1412
SN IIn	282
SN Ia-91T-like	248
SN Ic	211
SN IIP	182
SN Ib	165
SN IIb	139
SLSN-I	109
SN Ic-BL	93
SN Ia-91bg-like	79
SN Ia-pec	55
SN Ib/c	49
SLSN-II	44
SN Ibn	40
SN I	37
SN	28
SN Iax[02cx-like]	27
SN Ia-CSM	13
SN Ib-pec	10
SN II-pec	10
SN Ib-Ca-rich	9
SN IIn-pec	5
SN Icn	3
SN IIL	3
SN Ic-pec	2
SN Ia-SC	2

TNS Reports Yearly Timeline (2022-01-10)

Discovery reports



Classification reports



“Brokers” activity

An example of AT reports for ZTF/Pan-STARRS discoveries reported by various groups (as of 2022-01-04)

All AT Reports

name	count(*) 1
ZTF	25414
ALeRCE	13289
AMPEL	2152
SGLF	1668
Fink	866
ANTARES	126
SNAD	65
None	20
ZUDS	11
ULL-ASTRO-MASTER	10
REFITT	10
SIRAH	4
ePESSTO+	3
HOLISMOKES	1
IMSNG	1
Global SN Project	1

ATs classified as SNe

name	count(*) 1
ZTF	8852
ALeRCE	1819
AMPEL	685
Fink	564
SGLF	172
ANTARES	8
REFITT	7
SIRAH	4
ePESSTO+	2
ULL-ASTRO-MASTER	2
None	2
Global SN Project	1
HOLISMOKES	1

All AT Reports

name	count(*) 1
Pan-STARRS1	40425
YSE	2352
None	3

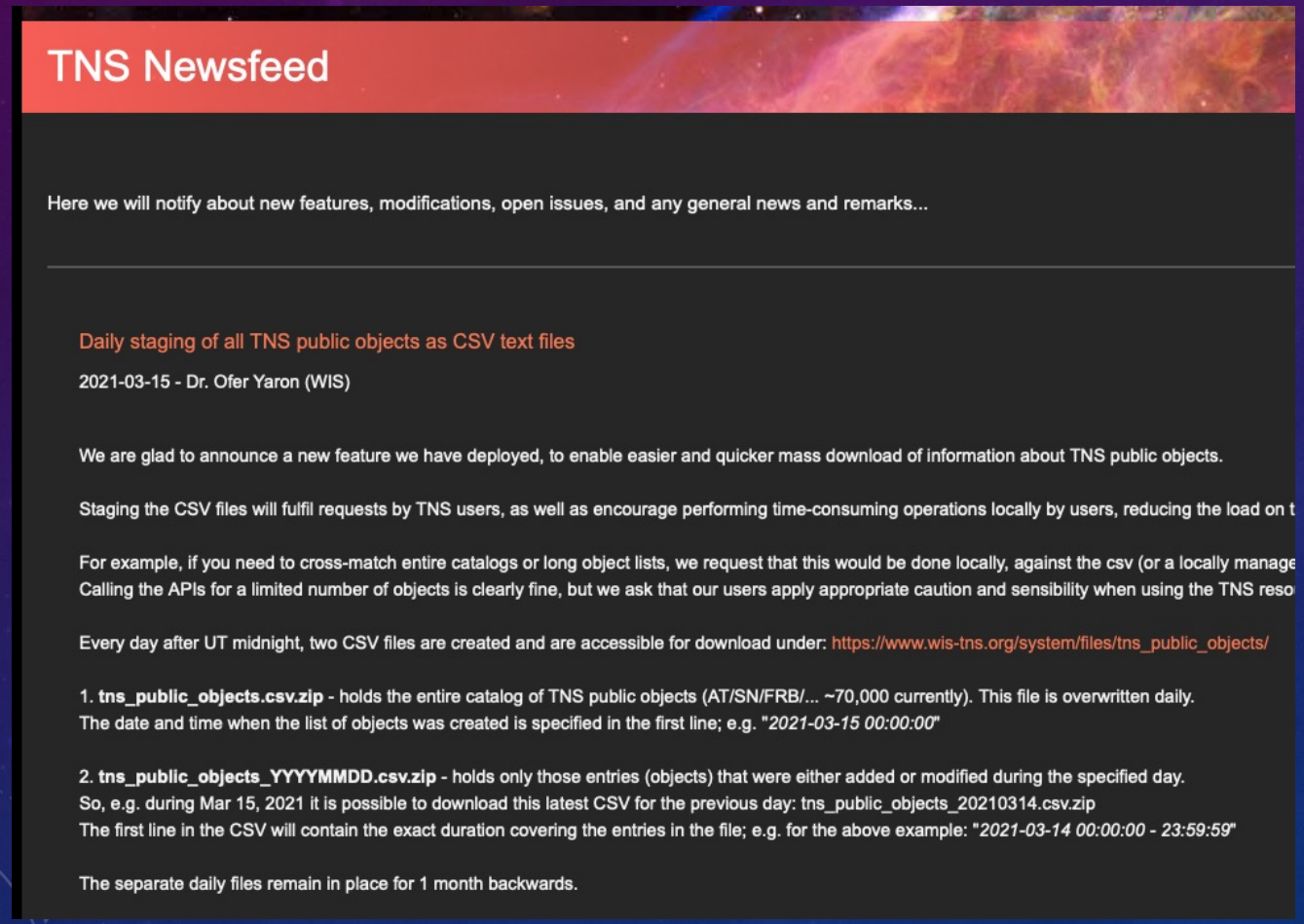
ATs classified as SNe

name	count(*) 1
Pan-STARRS1	5264
YSE	433

www.wis-tns.org/content/tns-getting-started
www.wis-tns.org/content/tns-newsfeed

TNS NewsFeed + Help Page

- Important updates/revisions are presented on the NewsFeed
- Use the help page, where also sample codes and examples are provided…



TNS Newsfeed

Here we will notify about new features, modifications, open issues, and any general news and remarks...

Daily staging of all TNS public objects as CSV text files

2021-03-15 - Dr. Ofer Yaron (WIS)

We are glad to announce a new feature we have deployed, to enable easier and quicker mass download of information about TNS public objects.

Staging the CSV files will fulfil requests by TNS users, as well as encourage performing time-consuming operations locally by users, reducing the load on t

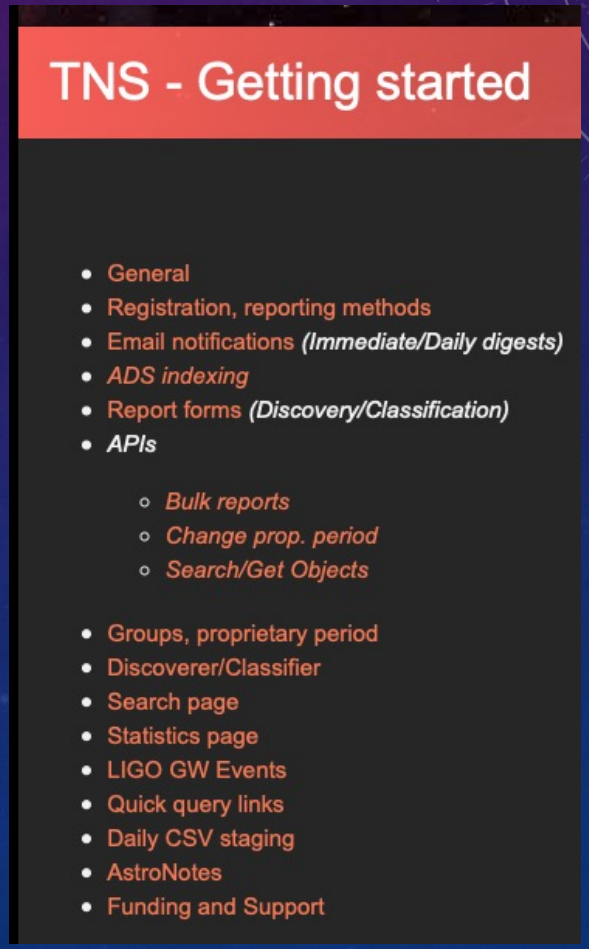
For example, if you need to cross-match entire catalogs or long object lists, we request that this would be done locally, against the csv (or a locally manage
Calling the APIs for a limited number of objects is clearly fine, but we ask that our users apply appropriate caution and sensibility when using the TNS reso

Every day after UT midnight, two CSV files are created and are accessible for download under: https://www.wis-tns.org/system/files/tns_public_objects/

1. **tns_public_objects.csv.zip** - holds the entire catalog of TNS public objects (AT/SN/FRB/... ~70,000 currently). This file is overwritten daily.
The date and time when the list of objects was created is specified in the first line; e.g. "*2021-03-15 00:00:00*"

2. **tns_public_objects_YYYYMMDD.csv.zip** - holds only those entries (objects) that were either added or modified during the specified day.
So, e.g. during Mar 15, 2021 it is possible to download this latest CSV for the previous day: tns_public_objects_20210314.csv.zip
The first line in the CSV will contain the exact duration covering the entries in the file; e.g. for the above example: "*2021-03-14 00:00:00 - 23:59:59*"

The separate daily files remain in place for 1 month backwards.



TNS - Getting started

- General
- Registration, reporting methods
- Email notifications *(Immediate/Daily digests)*
- *ADS indexing*
- Report forms *(Discovery/Classification)*
- *APIs*
  - *Bulk reports*
  - *Change prop. period*
  - *Search/Get Objects*
- Groups, proprietary period
- Discoverer/Classifier
- Search page
- Statistics page
- LIGO GW Events
- Quick query links
- Daily CSV staging
- AstroNotes
- Funding and Support

APIs, Bulk downloads

- A Sandbox environment exists for experimentation with the APIs (both for submission and retrieval of info)

  All API development must be performed against the sandbox!!!

  https://sandbox.wis-tns.org
  https://sandbox.wis-tns.org/api

- APIs are in place for:
  - the submission of Discovery (AT) and Classification reports.
  - Searching of objects (by coords, names – IAU/internal)
  - Retrieving object details

- CSV/TSV downloads are available from the Search page (also in a scriptable way)

e.g. https://www.wis-tns.org/search?&&classified_sne=1&date_start%5Bdate%5D=2021-01-01&format=csv&num_page=100&page=0 ←[0..N]

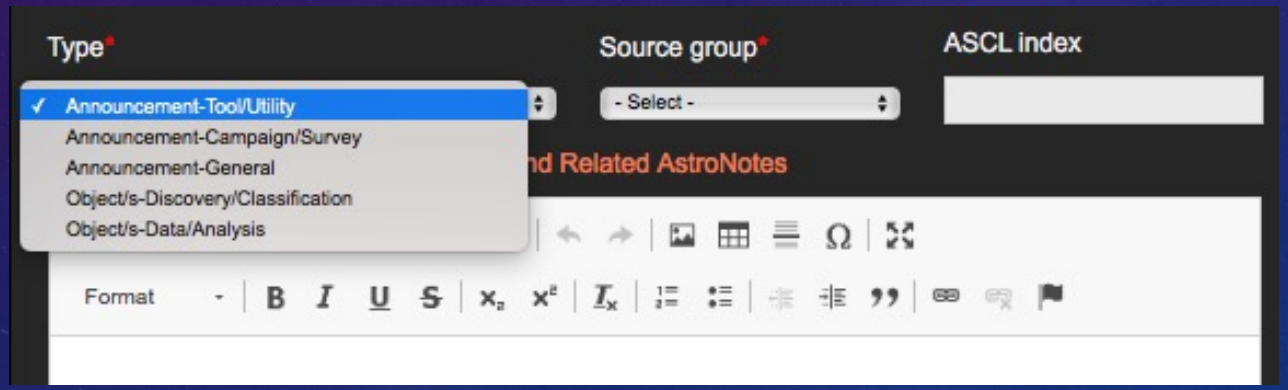
- A CSV of all public objects (as well as daily "delta" lists) are available for download, in order to allow for easy local managing of the TNS data and to perform "heavy" operations locally (such as cross-matching entire catalogs or long object lists)

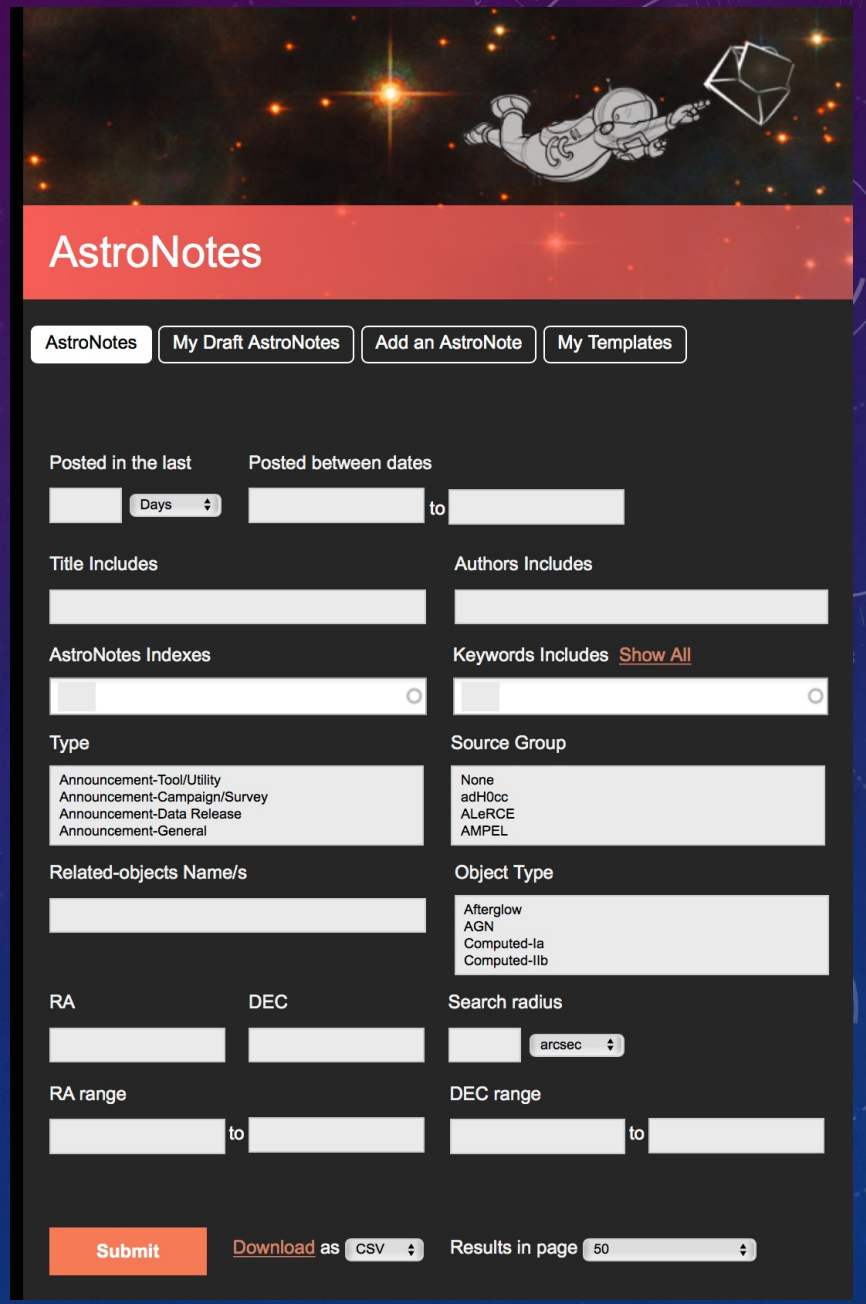
https://www.wis-tns.org/system/files/tns_public_objects/tns_public_objects.csv.zip
Or using curl (with User-Agent and api_key) for a daily csv:

```
curl -X POST -H 'user-agent: tns_marker{"tns_id":YOUR_BOT_ID,"type": "bot", "name":" YOUR_BOT_NAME"}'
-d 'api_key=YOUR_API_KEY' https://www.wis-tns.org/system/files/tns_public_objects/tns_public_objects_20220112.csv.zip > tns_public_objects_20220112.csv.zip
```

AstroNotes!!!

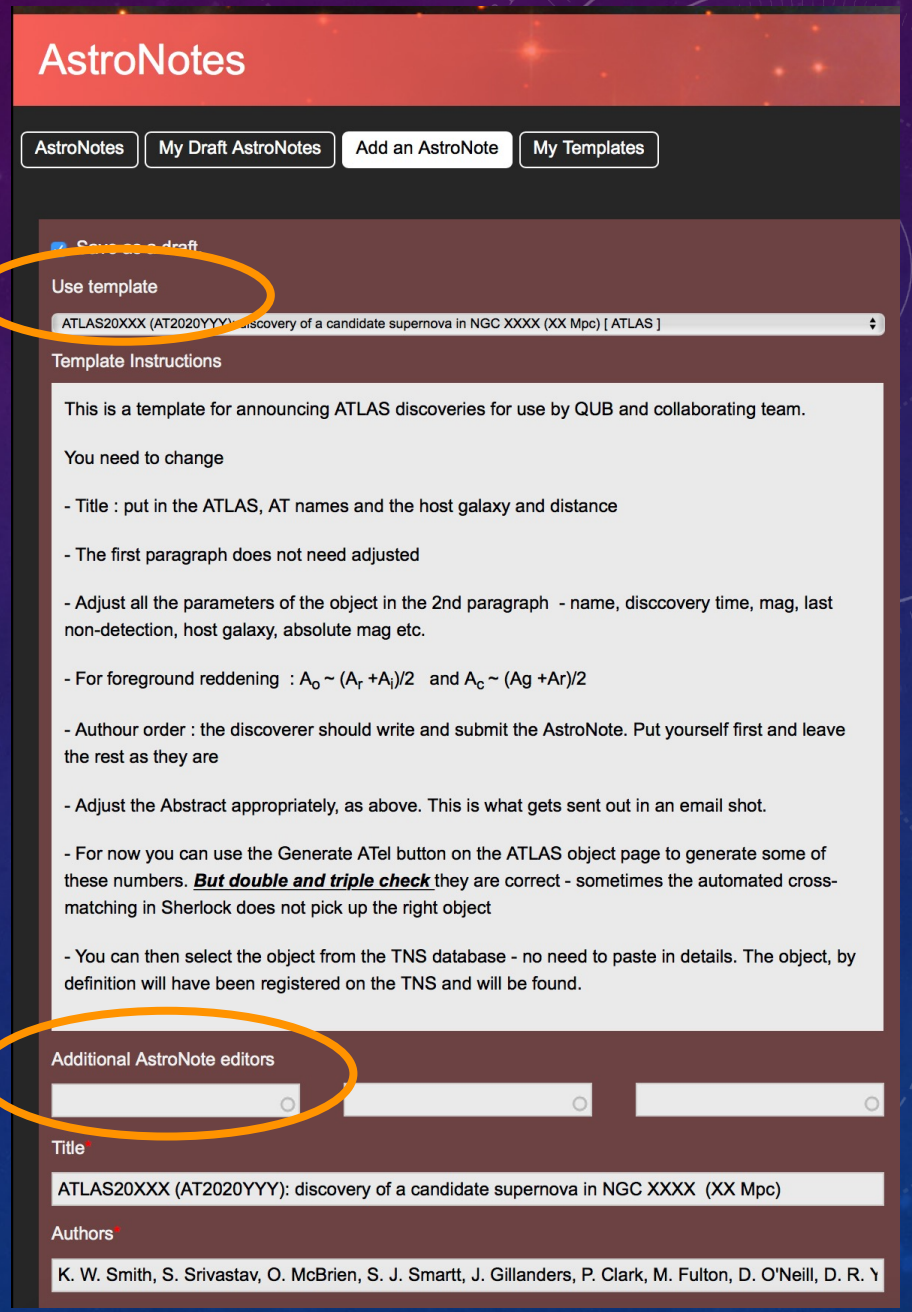
- A sub-system within the TNS (so no need to register to an additional service for creating and receiving these notifications).
- Enabling the distribution of notifications in a very flexible (yet accurate) way, directly coupled to the related objects, searchable and citable.
- Can create either an object-related (discovery, classification, analysis) or an “announcement” notification, without any restrictions, limitations or penalties…





AstroNotes!!!

- A “sub-system” within the TNS.
- Enabling the distribution of notifications in a very flexible way, directly coupled to the related objects, searchable and citable.
- Easy managing and use of Templates, for quicker writing of a new AstroNote.
- Easy sharing of Drafts with the colleagues; allowing definition of several editors to continue editing the draft until submission.



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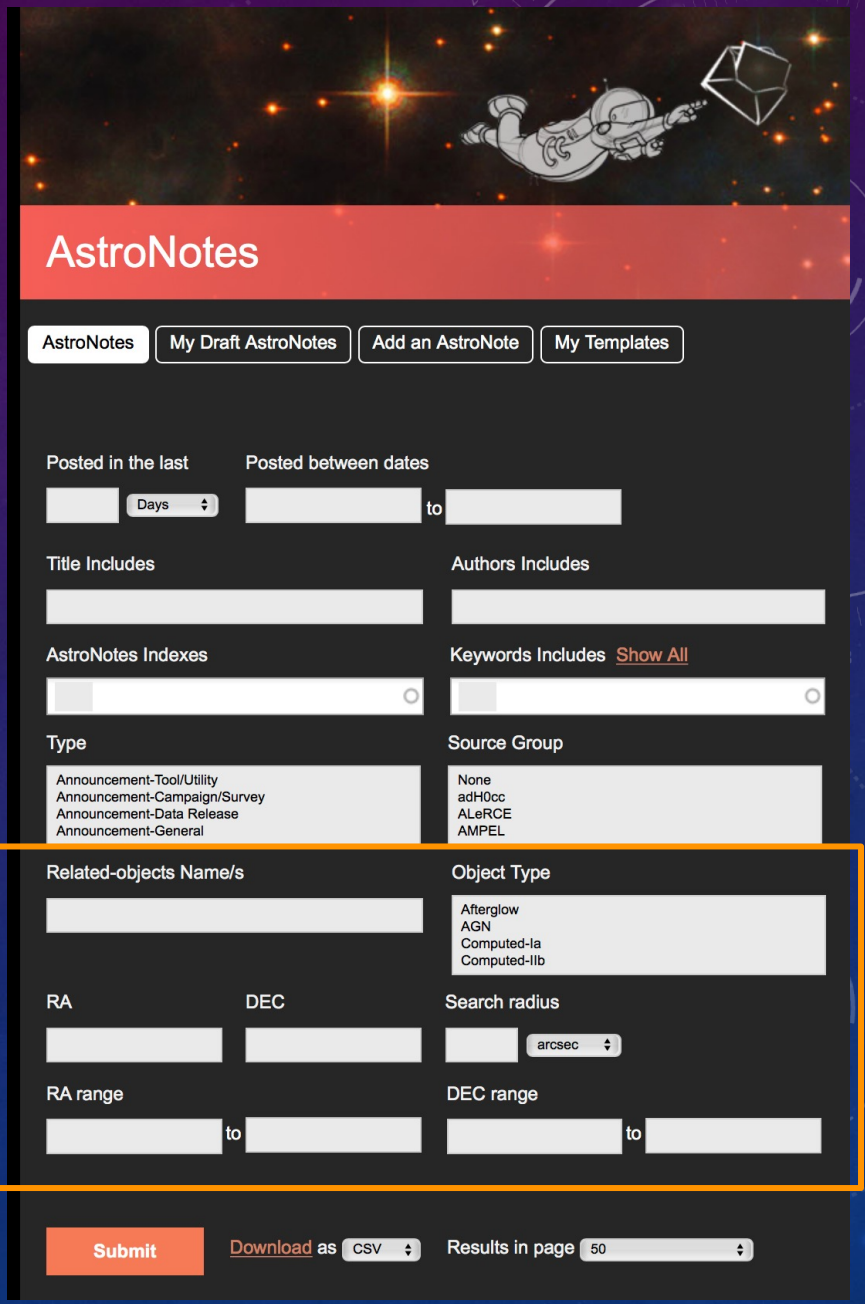
- Many Search options, including by object names, types and coords.



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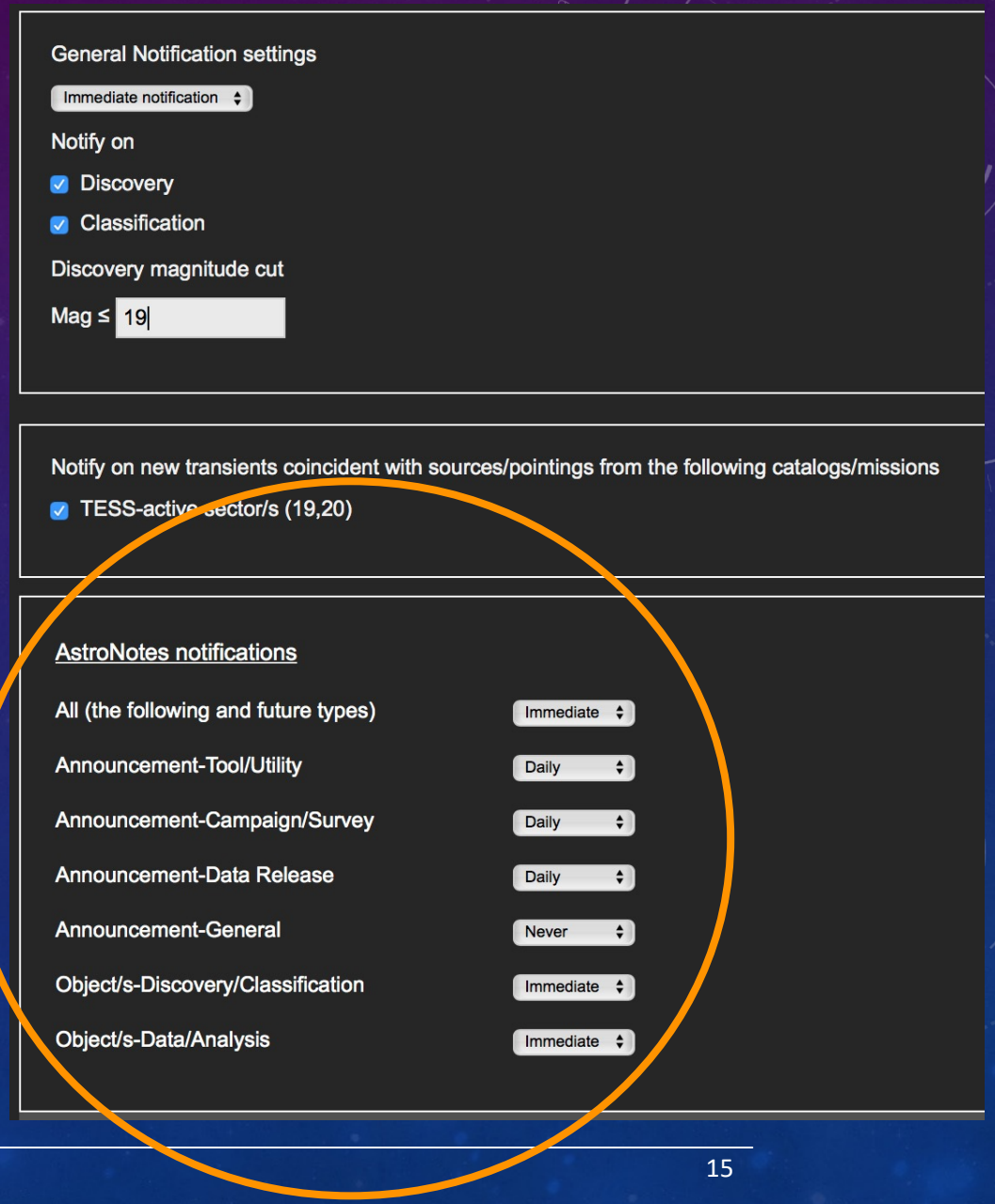
- Easy sharing of Drafts with the colleagues; allowing definition of several editors to continue editing the draft until submission.
- Many Search options, including by object names, types and coords.
- Possible to define on your My Account page which types of notifications you wish to receive, and in which manner.

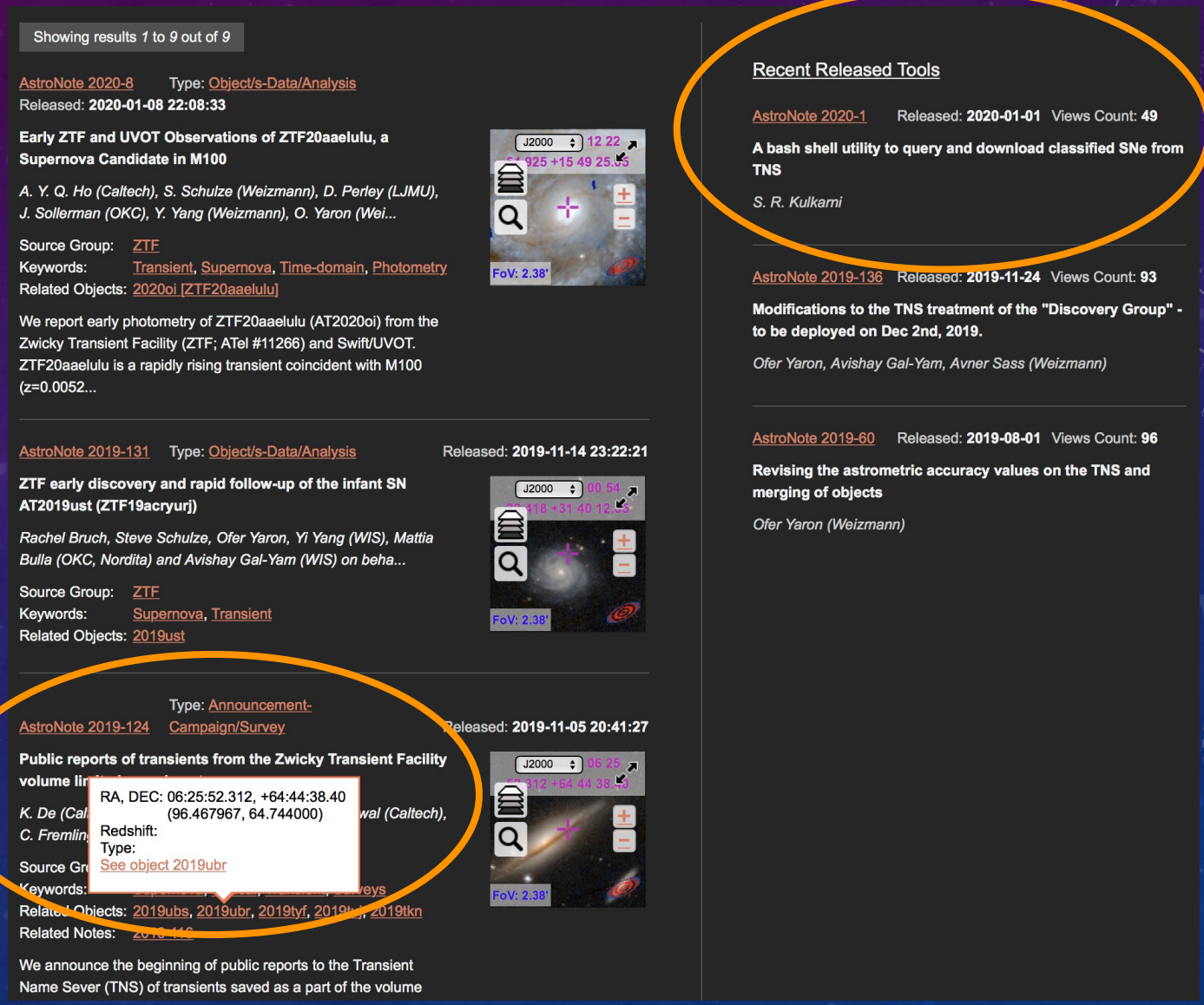


AstroNotes!!!

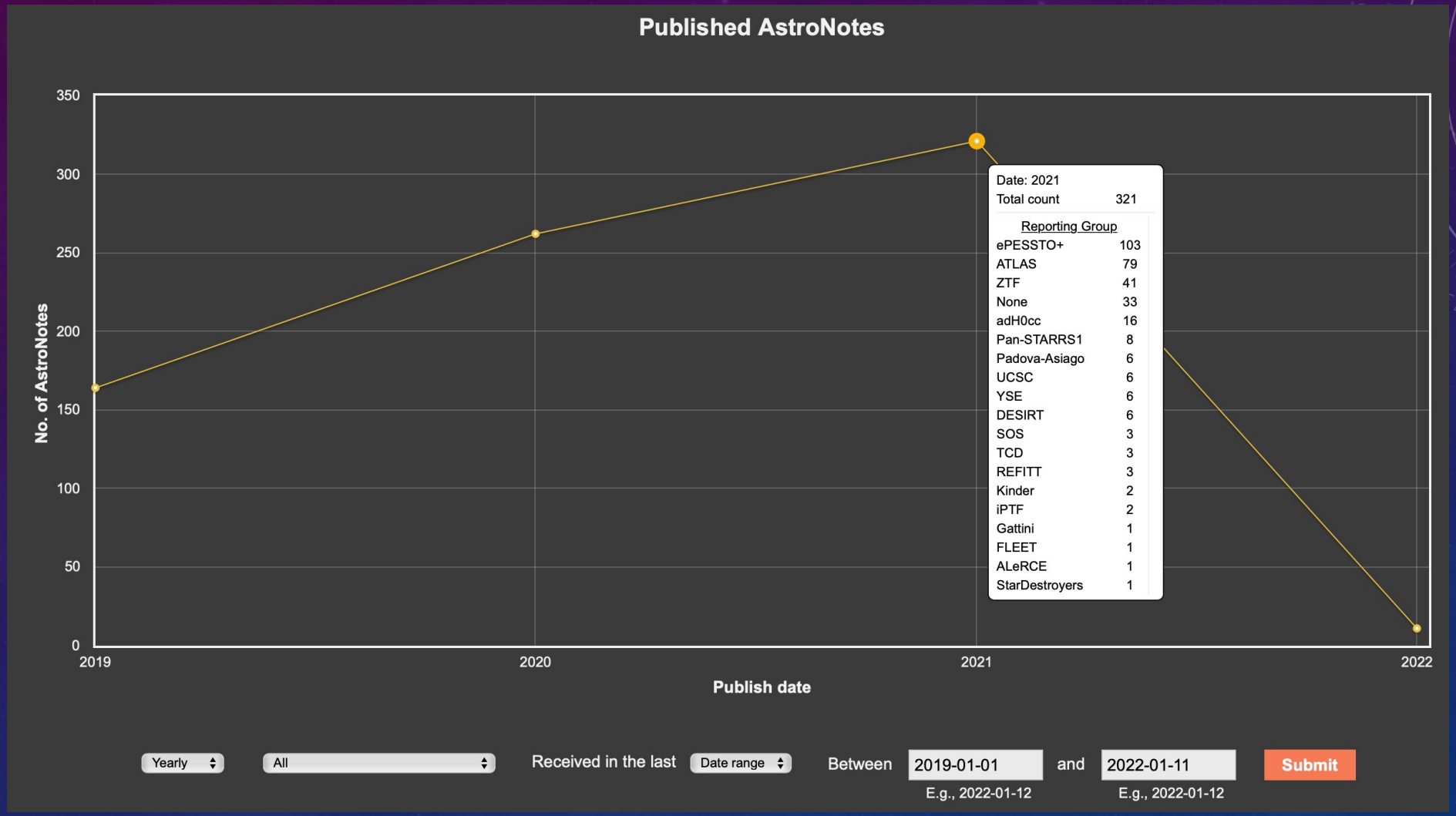
A query for ZTF AstroNotes:

- Major surveys and groups of the Transients community have already moved to using solely AstroNotes – ATLAS, Pan-Starrs, PESSTO, ZTF…

Clicking on an object name overlays its basic details, with a link directly to the object page



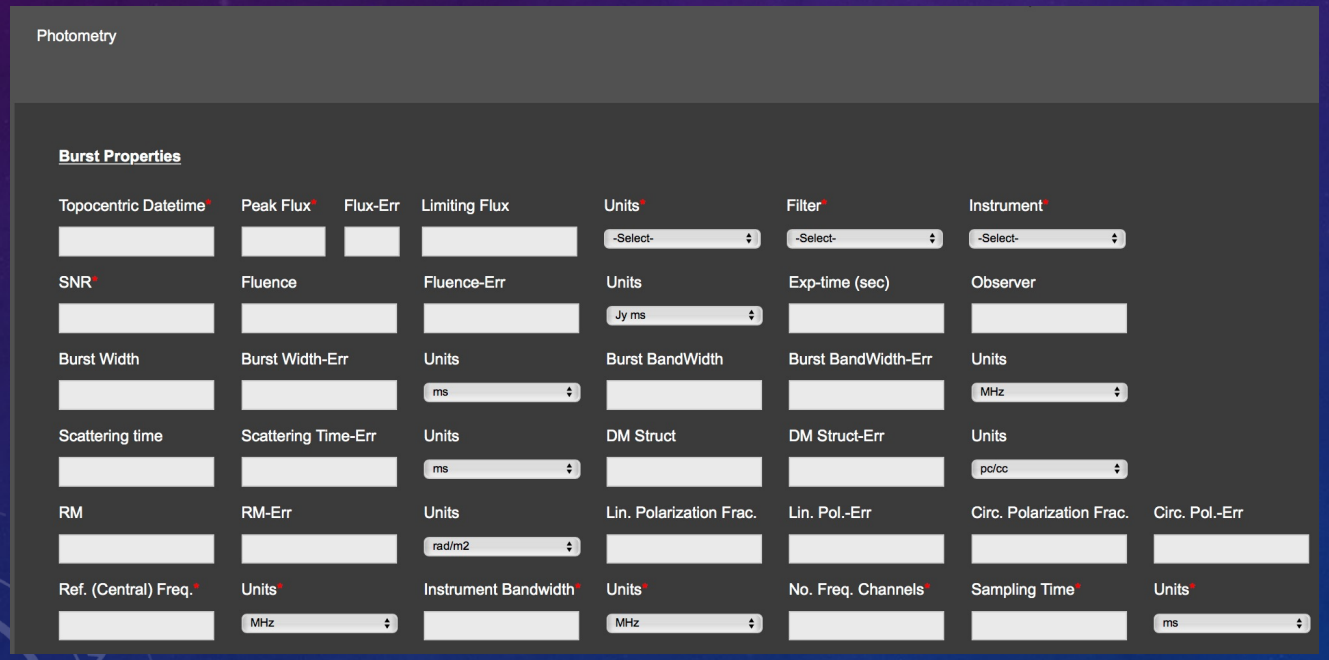
AstroNotes - Stats

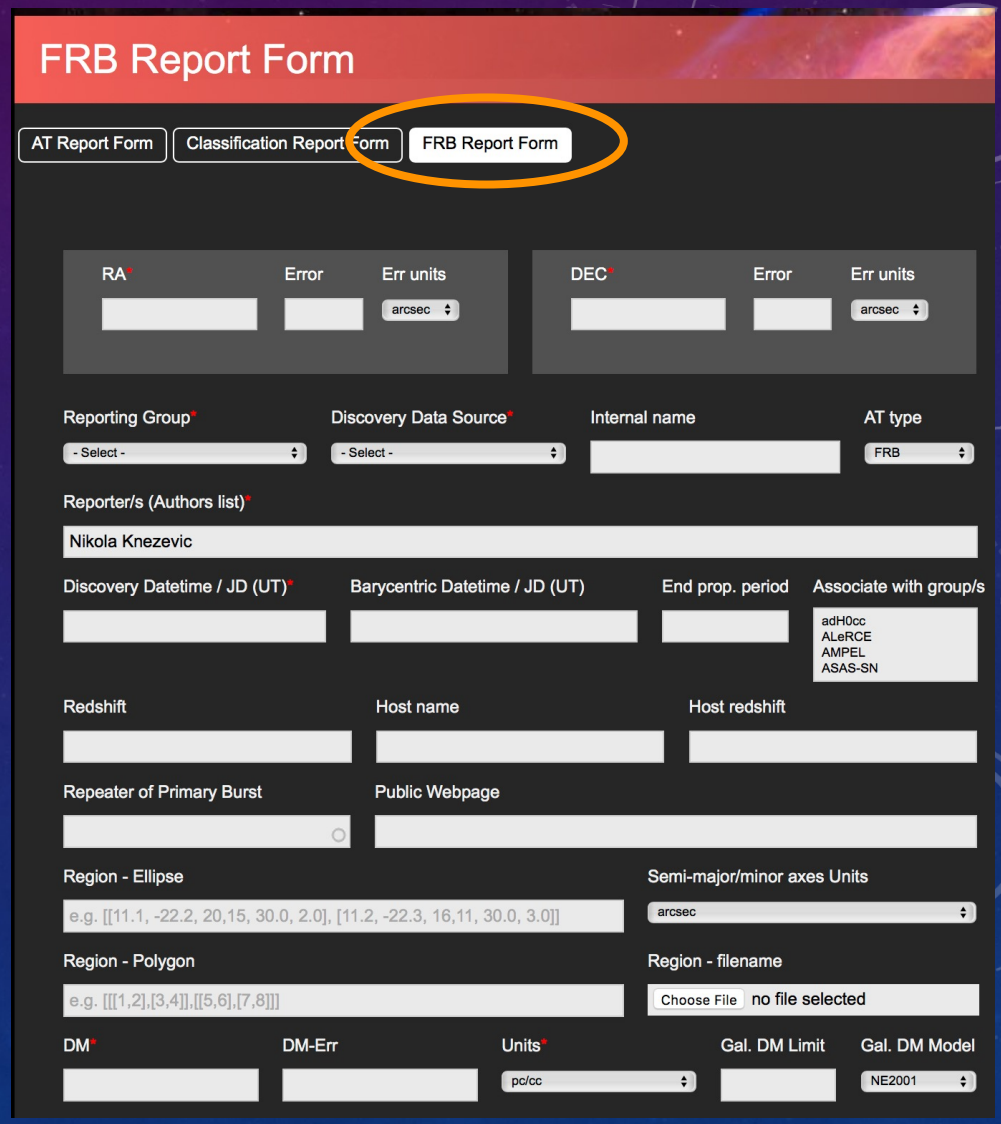


Monotonic increase, currently dominated by ePESSTO+, ATLAS and ZTF

Area Transients - The new guys in town (well, already since 2020-03)... FRBs

- Main coordination with CHIME and representatives of the FRB community
- A separate engine for designation of names: (FRB)YYYYMMDDabc, coexisting next to the AT/SN names
- FRB-Catalog fully ingested to the TNS





Fast Radio Bursts

FRB Advanced Search

Repeater: Repeater | Repeater of | FRB with measured redshift

DM Range: to | RM Range: to

SNR Range: to | Flux Range: to

Show main query | Explain main query

Submit | Download as CSV | Download as TSV | Results in page 50

Columns to display

Showing results 1 to 2 out of 2

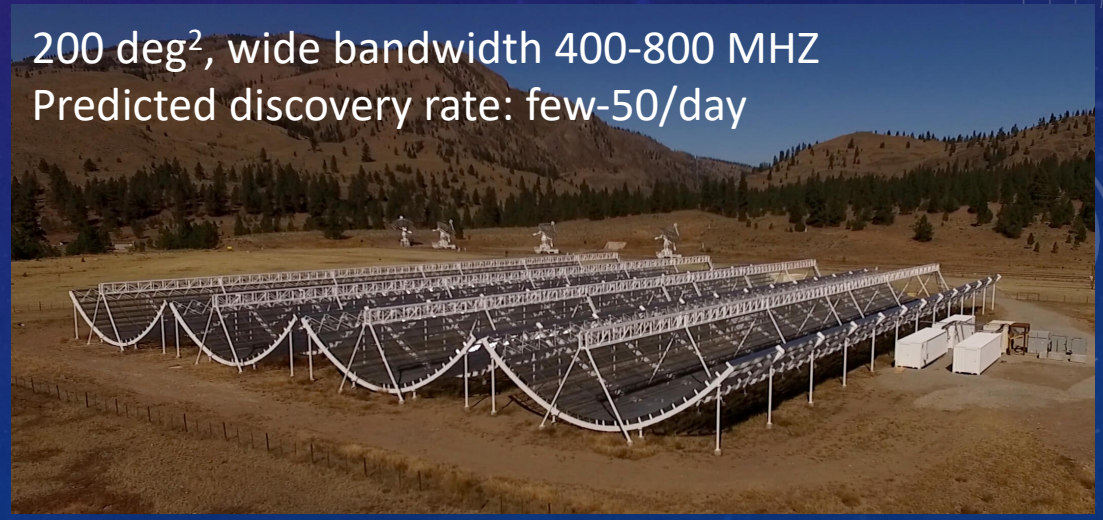
ID	Name	Reps	Class	RA	DEC	Obj. Type	Repeater of Primary Burst	DM (Err)	Galactic DM Limit	Barycentric Datetime
51465	FRB 20191202A	1		02:15:60.000	+33:00:00.00	FRB	FRB 20191202A	680 (68) pc/cc	24 (NE2001)	
51466	FRB 20190807A	1		00:08:00.000	+02:00:00.00	FRB	FRB 20191202A	430 (43) pc/cc	23 (YMW16)	

- Repeaters are distinct objects on the TNS, allowing flexible associations of multiple bursts with the Primary Burst.

CHIME/FRB Discovery of Eight New Repeating Fast Radio Burst Sources

The CHIME/FRB Collaboration, B. C. Andersen,[1,2] K. Bandura,[3,4] M. Bhardwaj,[1,2] P. Boubel,[1,2] M. M. Boyce,[5] P. J. Boyle,[1,2] C. Brar,[1,2] T. Cassanelli,[6,7] P. Chawla,[1,2]

The discovery of the first repeating FRB source, FRB 121102, at a dispersion measure DM $\simeq$ 560 pc cm^{-3} (Spitler et al. 2014, 2016), eliminated cataclysmic models as the only means for producing FRB emission. The repetitive nature of FRB 121102 enabled sub-arcsecond localization of the source via radio interferometry and subsequent optical identification of the low-metallicity host galaxy

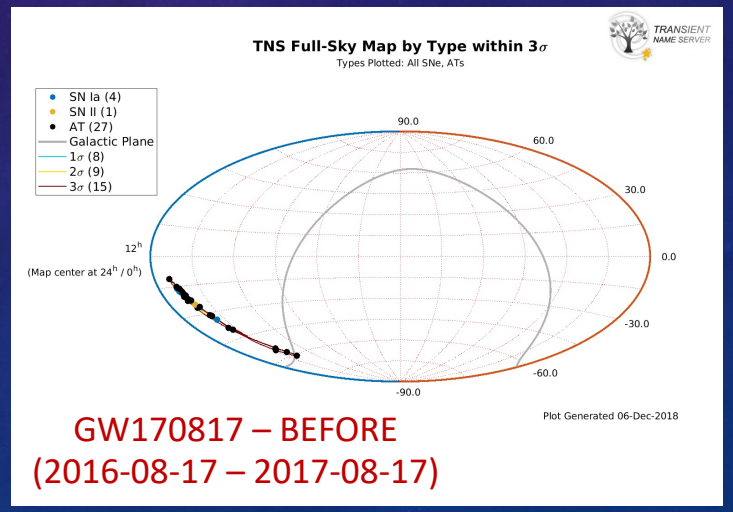


Current LIGO pages on the TNS – a clarification

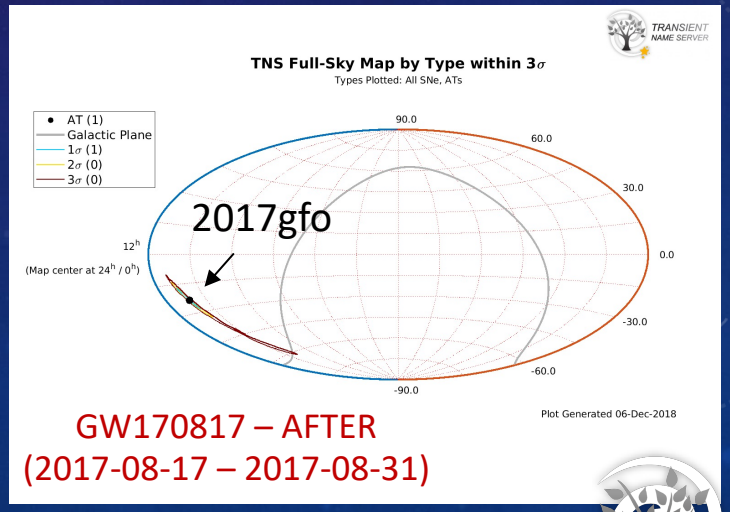
- During O1-O3 observing runs, we ingested to the TNS the reported LIGO events and based on the localization maps (HEALPix) provided to the community maps and tables of the known transients (ATs) on the TNS discovered within half a year BEFORE the GW event and the discovered transients within the localizations during the 2 weeks AFTER the event.
- The plan is to continue doing so for the future LVK runs. Any ideas and recommendations are clearly welcome.

LIGO GW

Event Date	Event Name	GraceDB	Instruments	Classification	Distance [Mpc] (Err)
2020-03-16 21:57:56	S200316bj	To GraceDB event page	H1, L1, V1	Mass-Gap: (99.57%) Terrestrial: (0.43%)	1177.983 (283.01)
2020-03-11 11:58:53	S200311bg	To GraceDB event page	H1, L1, V1	BBH: (100%) Terrestrial: (0%)	1114.588 (174.59)
2020-03-02 01:58:11	S200302c	To GraceDB event page	H1, V1	BBH: (88.96%) Terrestrial: (11.04%)	1820.133 (536.10)
2020-02-25 06:04:21	S200225q	To GraceDB event page	H1, L1	BBH: (95.77%) Terrestrial: (4.23%)	994.913 (187.86)
2020-02-24 22:22:34	S200224ca	To GraceDB event page	H1, L1, V1	BBH: (100%) Terrestrial: (0%)	1574.996 (322.37)
2020-02-19 09:44:15	S200219ac	To GraceDB event page	H1, L1, V1	BBH: (96.4%) Terrestrial: (3.6%)	3533.071 (1031.11)
2020-02-13 04:10:40	S200213t	To GraceDB event page	H1, L1, V1	Terrestrial: (37.05%)	200.919 (80.01)
2020-02-08 13:01:17	S200208q	To GraceDB event page	H1, L1, V1	BBH: (99.34%) Terrestrial: (0.66%)	2142.007 (459.01)
2020-01-29 06:54:58	S200129m	To GraceDB event page	H1, L1, V1	BBH: (100%) Terrestrial: (0%)	754.616 (193.72)
2020-01-28 02:20:11	S200128d	To GraceDB event page	H1, L1	BBH: (96.9%) Terrestrial: (3.1%)	3701.586 (1264.51)



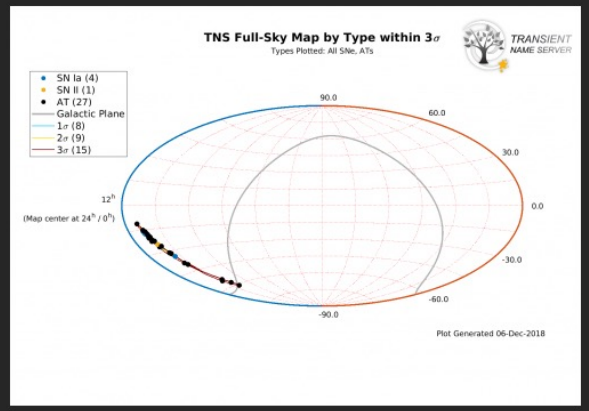
GW170817 – BEFORE
(2016-08-17 – 2017-08-17)



GW170817 – AFTER
(2017-08-17 – 2017-08-31)

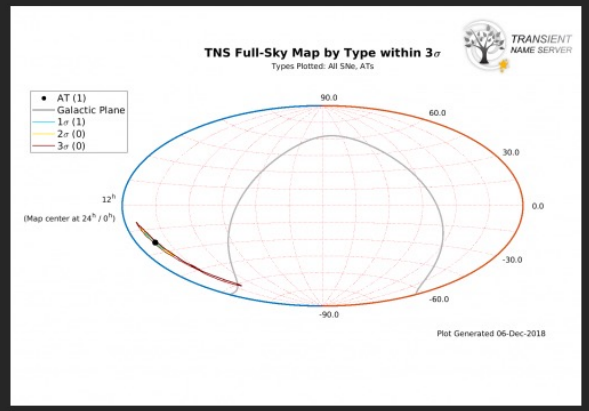
Current LIGO pages on the TNS – a clarification

TNS Transients discovered BEFORE the GW event
(within date range 2016-08-17 - 2017-08-17)



Skymap before JSON format transient list before TSV format transient list before

TNS Transients discovered AFTER the GW event
(within date range 2017-08-17 - 2017-08-31)



Skymap after JSON format transient list after TSV format transient list after

TNS Transients within localization

Discovered AFTER the GW event (2017-08-17 12:41:04 - 2017-08-31 12:41:04):

Name	RA	DEC	Type	Discovery Date	Discovery Mag	Filter	Source Group	Probability	Sigma
AT 2017gfo	13:09:48.089	-23:22:53.35	Kilonova Swope SN	2017-08-17 23:31:12	17.3	Sloan-i	Survey	0.063670	1

Discovered BEFORE the GW event (2016-08-17 12:41:04 - 2017-08-17 12:41:04):

Name	RA	DEC	Type	Discovery Date	Discovery Mag	Filter	Source Group	Probability	Sigma
AT 2016frh	13:08:10.020	-21:51:00.86		2016-08-28 17:06:43	17.9	Gaia-G	GaiaAlerts	0.335878	1
AT 2016fru	13:22:28.700	-26:22:55.06		2016-08-30 05:03:50	18.92	Gaia-G	GaiaAlerts	0.993992	3
AT 2016hrh	14:35:01.810	-57:45:44.96		2016-10-22 03:37:26	18.77	Gaia-G	GaiaAlerts	0.993315	3
AT 2016hst	14:39:44.180	-60:55:39.83		2016-10-23 09:37:26	18.59	Gaia-G	GaiaAlerts	0.996566	3
AT 2016ity	13:39:32.600	-39:04:05.88		2016-12-07 09:12:57	17.69	Gaia-G	GaiaAlerts	0.983240	3
AT 2016iuo	14:09:25.370	-55:17:54.35		2016-12-08 21:31:40	18.22	Gaia-G	GaiaAlerts	0.997280	3
AT 2016iuu	14:18:09.130	-54:35:54.28		2016-12-10 03:33:07	18.83	Gaia-G	GaiaAlerts	0.980654	3
AT 2017amm	13:00:31.951	-19:49:44.77		2017-02-03 14:35:31	19.98	PS1-w	Pan-STARRS1	0.432000	1

Clarifications / to summarize

- The TNS manages discovery & classification information (data), NOT extended LCs, spectral sequences etc…
  For this, data repositories such as WISeREP are relevant.

- Initiated mainly for SN candidates, the TNS also handles other extra-galactic transients, including novae (CVs), AGN flares, TDEs, Kilonovae… BUT NOT variable stars, asteroids or other such galactic/local variable/moving sources.

PLEASE DO NOT submit varstars/moving objects but only secure extra-galactic transient candidates!!!

- "Area Transients" are also officially joining the TNS: FRBs, and soon also GRBs, GW events.
  (In future more sophisticated cross-matching and association capabilities should be implemented – both on the TNS, and hopefully also by the additional utilities being developed.)

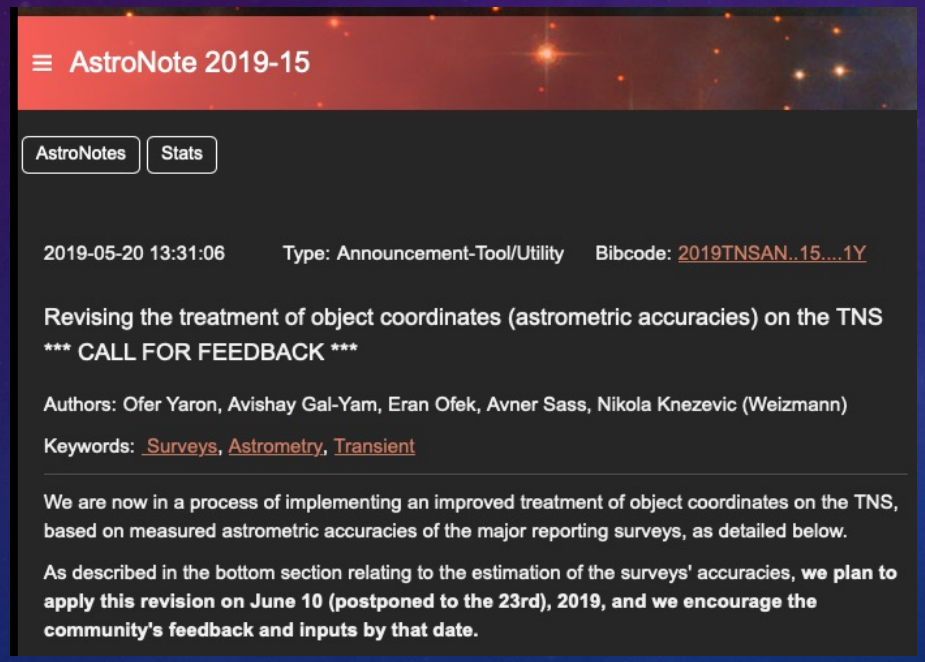
- Classifications must be supported by a spectrum (not relevant for the area transients), and currently the TNS only switches the prefixes from AT to SN. (TDEs, Kilonovae… remain AT until an official decision will be made.)

- API sample codes are available for download on the help page.

- For any questions/feedback/suggestions related to the use of the TNS, its APIs, AstroNotes, please do not hesitate to contact us: www.wis-tns.org/content/contact-us (or me in person)

Astrometric accuracies of surveys on the TNS

- Several reporting groups/surveys have a defined astrometric accuracy that is significantly better than the default threshold of 5 arcsec.
- This affects the setting of an object's "principal" coordinates (in case of multiple reports from several groups), and also the decision on the creation of a new object vs association with an existing one.
- See AstroNotes 2019-15 and 2019-37 for detailed descriptions, and do let us know if the astrometric accuracy of certain groups need to be considered/revised.



≡ AstroNote 2019-15

AstroNotes | Stats

2019-05-20 13:31:06 Type: Announcement-Tool/Utility Bibcode: 2019TNSAN..15....1Y

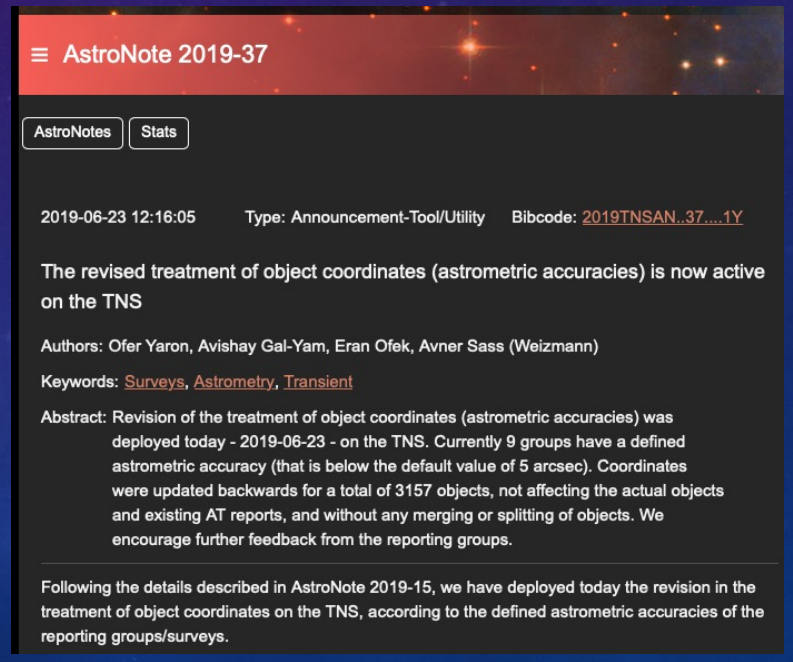
Revising the treatment of object coordinates (astrometric accuracies) on the TNS *** CALL FOR FEEDBACK ***

Authors: Ofer Yaron, Avishay Gal-Yam, Eran Ofek, Avner Sass, Nikola Knezevic (Weizmann)

Keywords: Surveys, Astrometry, Transient

We are now in a process of implementing an improved treatment of object coordinates on the TNS, based on measured astrometric accuracies of the major reporting surveys, as detailed below.

As described in the bottom section relating to the estimation of the surveys' accuracies, **we plan to apply this revision on June 10 (postponed to the 23rd), 2019, and we encourage the community's feedback and inputs by that date.**



≡ AstroNote 2019-37

AstroNotes | Stats

2019-06-23 12:16:05 Type: Announcement-Tool/Utility Bibcode: 2019TNSAN..37....1Y

The revised treatment of object coordinates (astrometric accuracies) is now active on the TNS

Authors: Ofer Yaron, Avishay Gal-Yam, Eran Ofek, Avner Sass (Weizmann)

Keywords: Surveys, Astrometry, Transient

Abstract: Revision of the treatment of object coordinates (astrometric accuracies) was deployed today - 2019-06-23 - on the TNS. Currently 9 groups have a defined astrometric accuracy (that is below the default value of 5 arcsec). Coordinates were updated backwards for a total of 3157 objects, not affecting the actual objects and existing AT reports, and without any merging or splitting of objects. We encourage further feedback from the reporting groups.

Following the details described in AstroNote 2019-15, we have deployed today the revision in the treatment of object coordinates on the TNS, according to the defined astrometric accuracies of the reporting groups/surveys.

Astrometric accuracies of surveys on the TNS