Supernova survey

Nozomu Tominaga

(NAOJ)

on behalf of Tomo-e SN team

5th Oct 2021

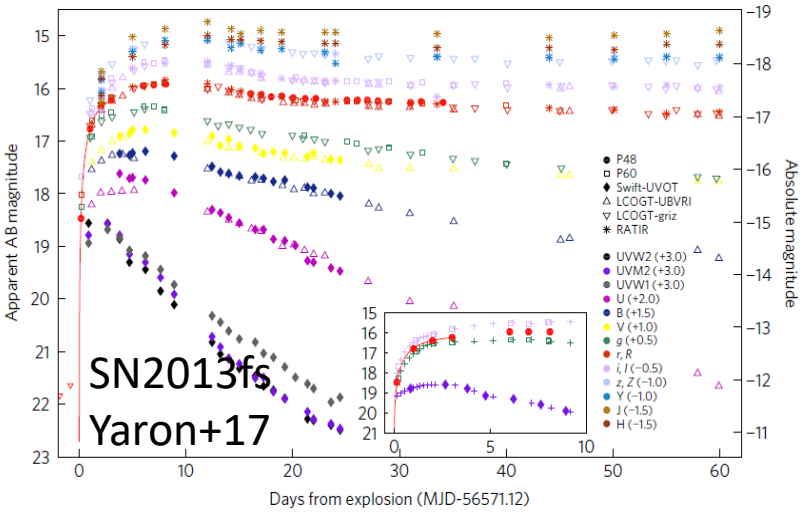
木曽シュミットシンポジウム

Contents

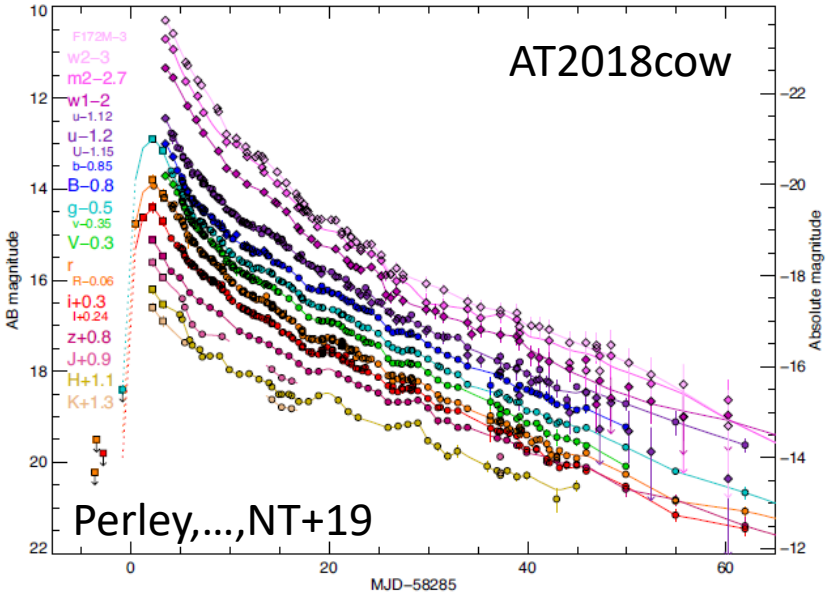
- Aims
- Survey structure
- Transient pipeline
- Improvements
- TNS transients observed by Tomo-e
- Prospects

Aims

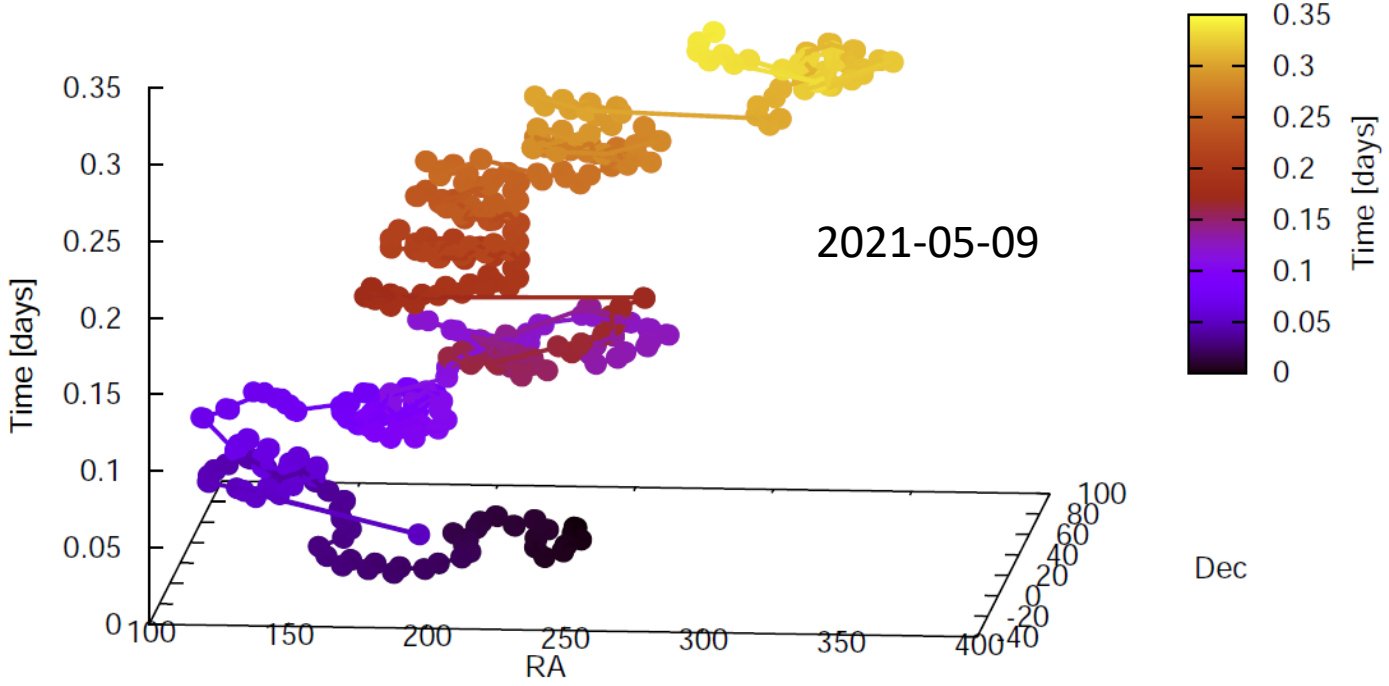
- Early supernovae
  - Last moment of massive stars
  - Progenitor system of SNeIa



- Rapid transients
  - Ultra-striped SNe?
  - Accretion disk around BHs?



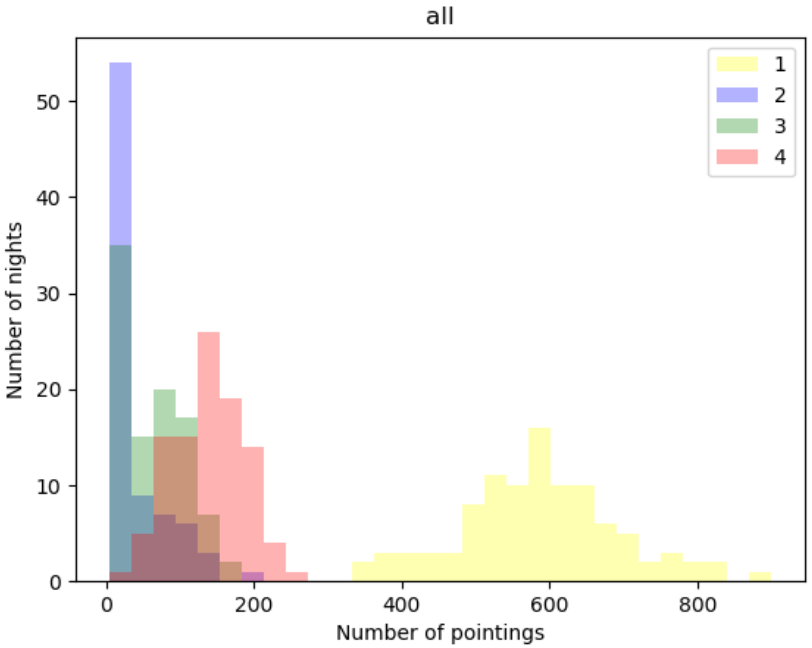
Survey structure

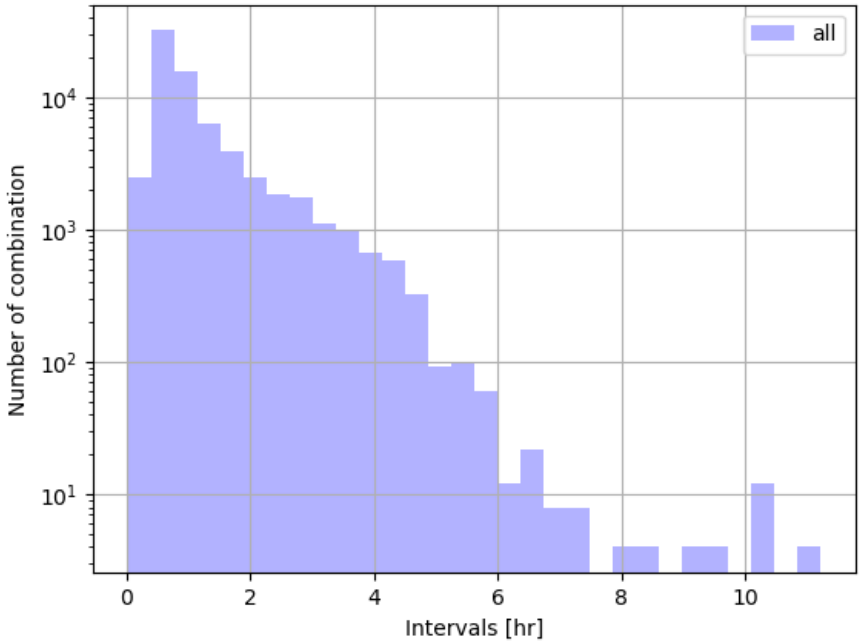


- All-sky survey
  - Exposure time: 9sec
  - 1 day cadence
- High-cadence survey
  - Exposure time: 6sec
  - 30min cadence – 3visits

Survey statistics

100nights w/ > 1200 exposures
(Apr 14, 2020 – May 21, 2021)





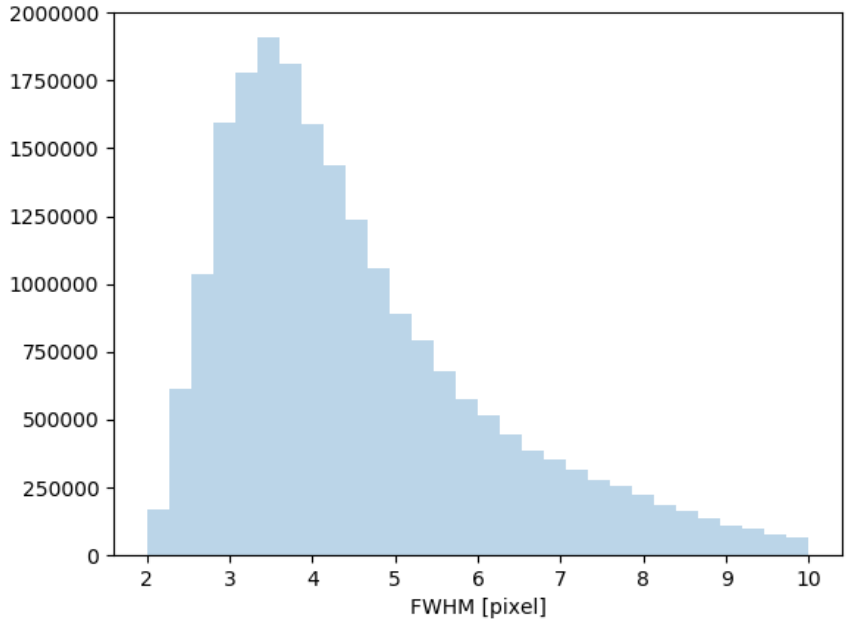
Independent pointings: 800 pointings (12000deg2, median)
Pointings with >=3 visits: 200 pointings (3000deg2, median)

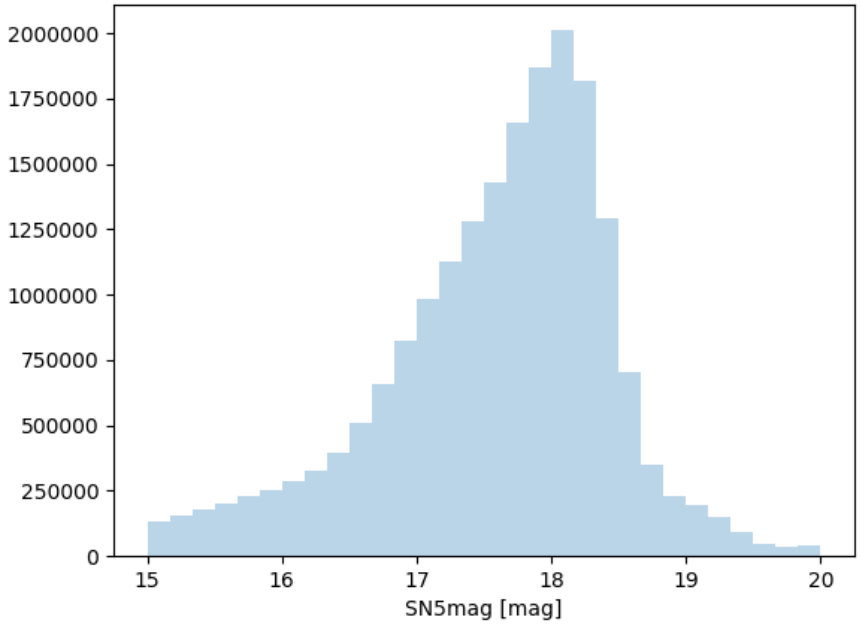
per night

Summary of images

2018-04-01 – 2021-06-06

2×10^7 fits (transferred to transient servers)





FWHM : 3.5 pixel (4.2 arcsec, mode)

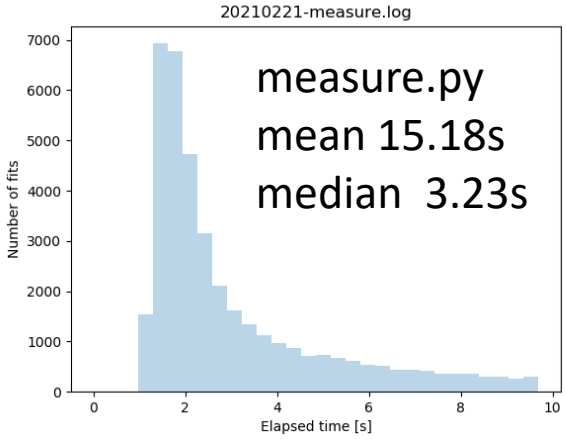
SN5mag : 17.8 mag (median)

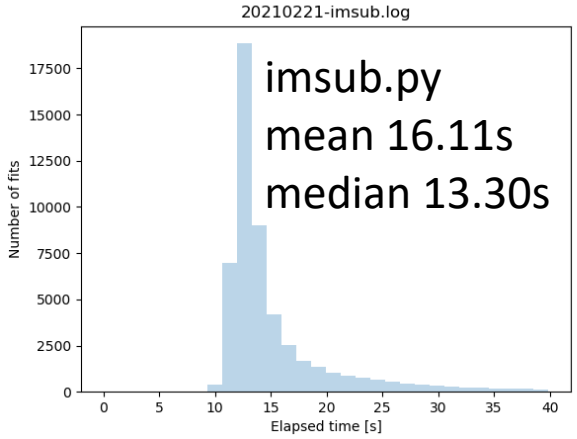
Transient pipeline

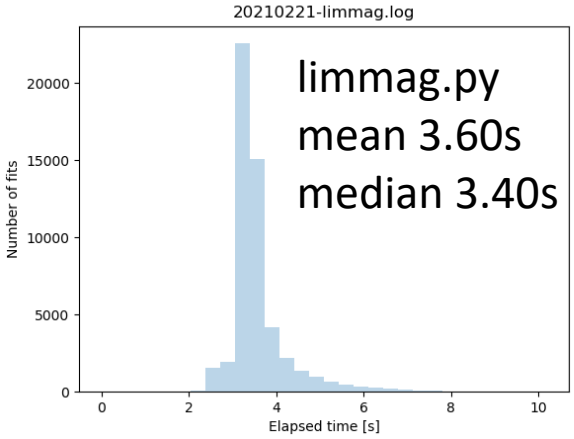
- pipeline.py
  - measure.py
    - Source detection, zeromag, sn5mag
  - imsub.py
    - Image subtraction, transient source detection
  - limmag.py
    - Limmag measurement with random aperture
  - forcedPhot.py
    - Forced photometry and image cutout of transients
  - tnsObj.py
    - Forced photometry and image cutout of TNS transients

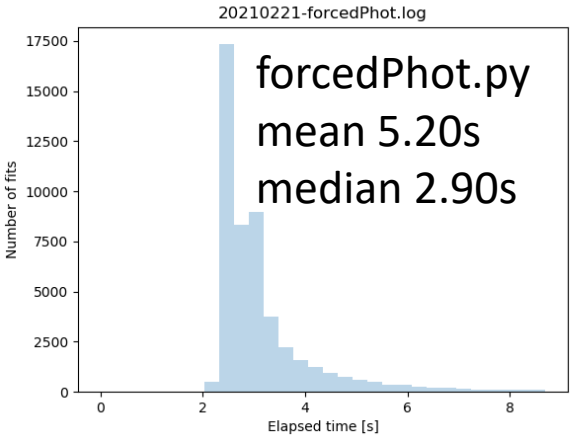
Toward realtime analysis

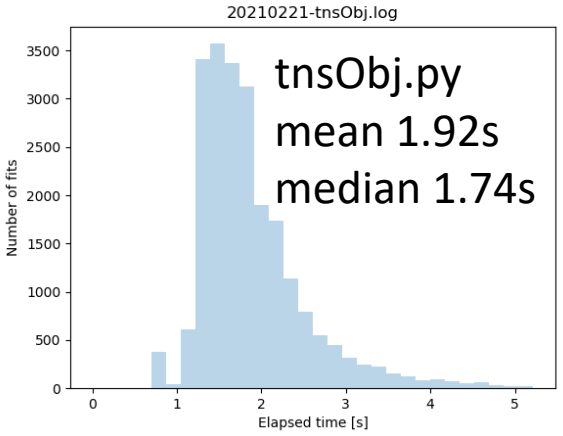
Feb 21, 2021 ~1800 exposures (= 150000 fits)











Total
mean 42.01s/fits
median 24.57s/fits

Transient system
128cores

The data processing will finish in **~0.6days**.

Toward realtime analysis

An autovacuum process of postgresql might lock the other processes.

Shinohara database -gwdata-

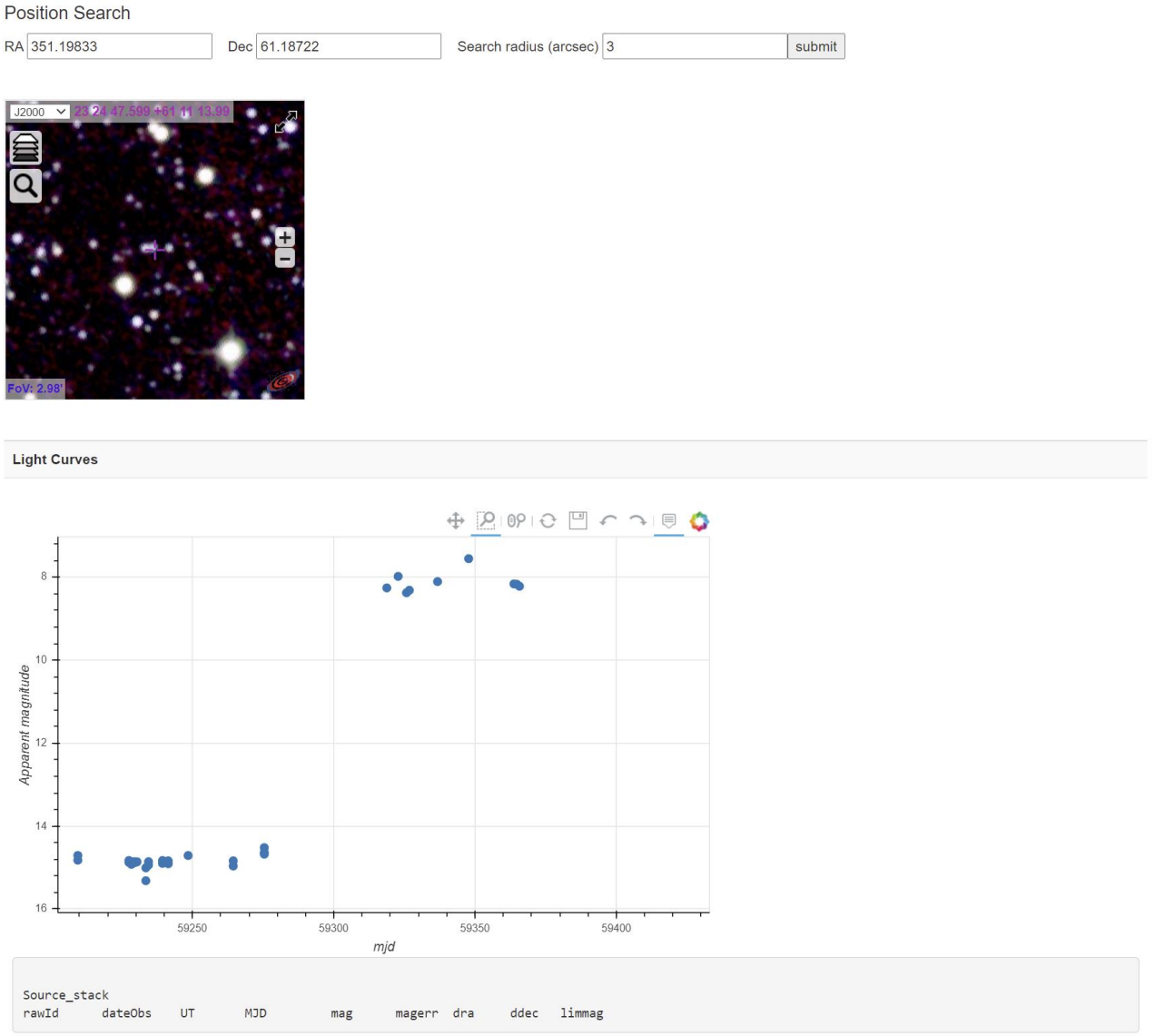
- Shinohara DB can be accessed via VPN
- Useful tables
  - analysis_stack: basic info of 2D images
  - source_stack: sources in raw images
  - source_sub: “real” sources in diff images
    - mp: LCs of known minor planets
  - variable: good sources in diff images (unique for ra,dec)
  - variable_star: good sources in diff images with star flag
  - transient: good variables (>= 2 detection)
  - forced_phot: forced photometry of transients
  - tag: classification and keywords after visual inspection
  - tns_forced_phot: forced photometry of TNS objs

Light curve position search

by Tanaka-san

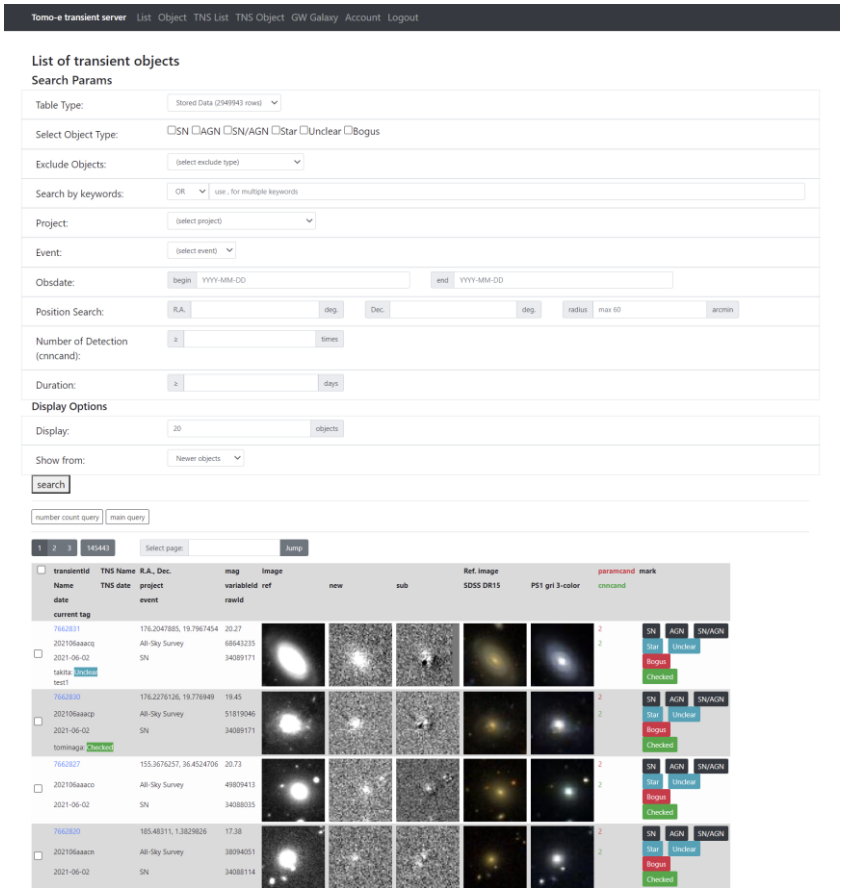
https://tomoe.mtk.ioa.s.u-tokyo.ac.jp/tomoesn/lc.php

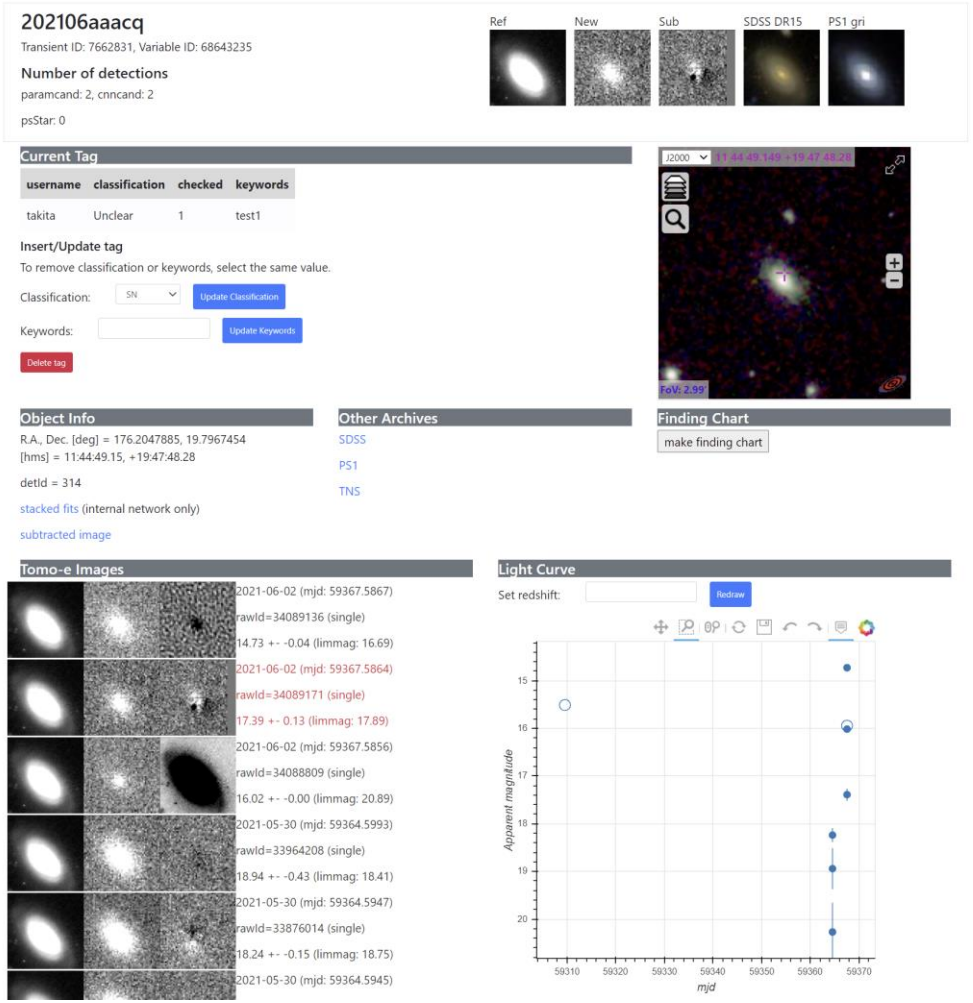
- V1405 Cas



Recent updates

- Web interface by Takita-san

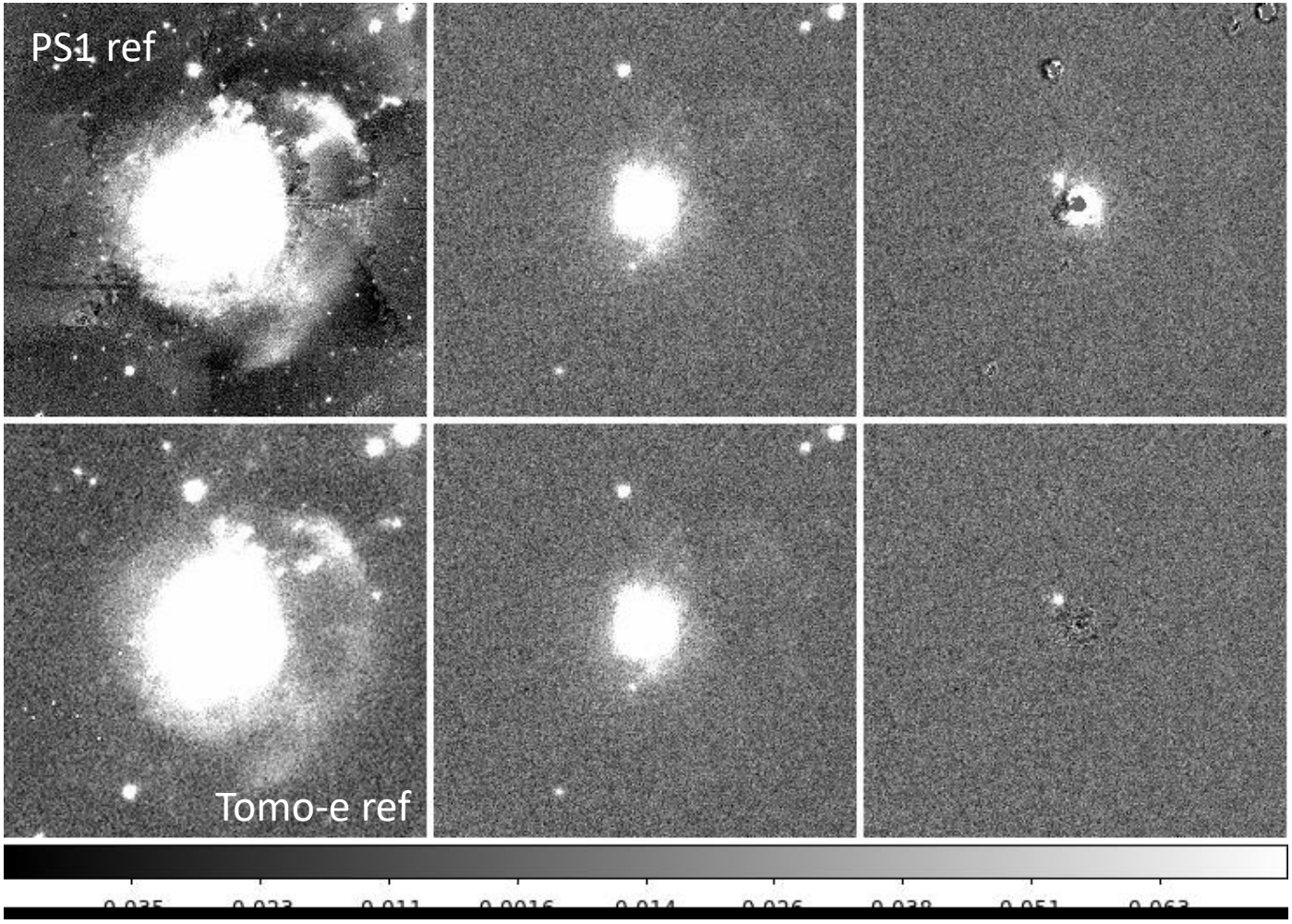




Recent updates

- Reference image by Niino-san

  SN2021gmj

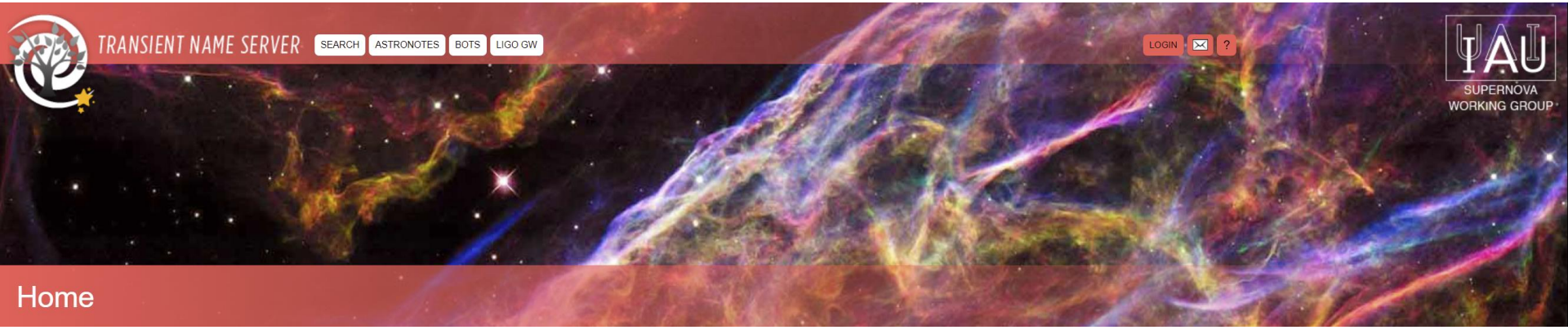


Recent updates

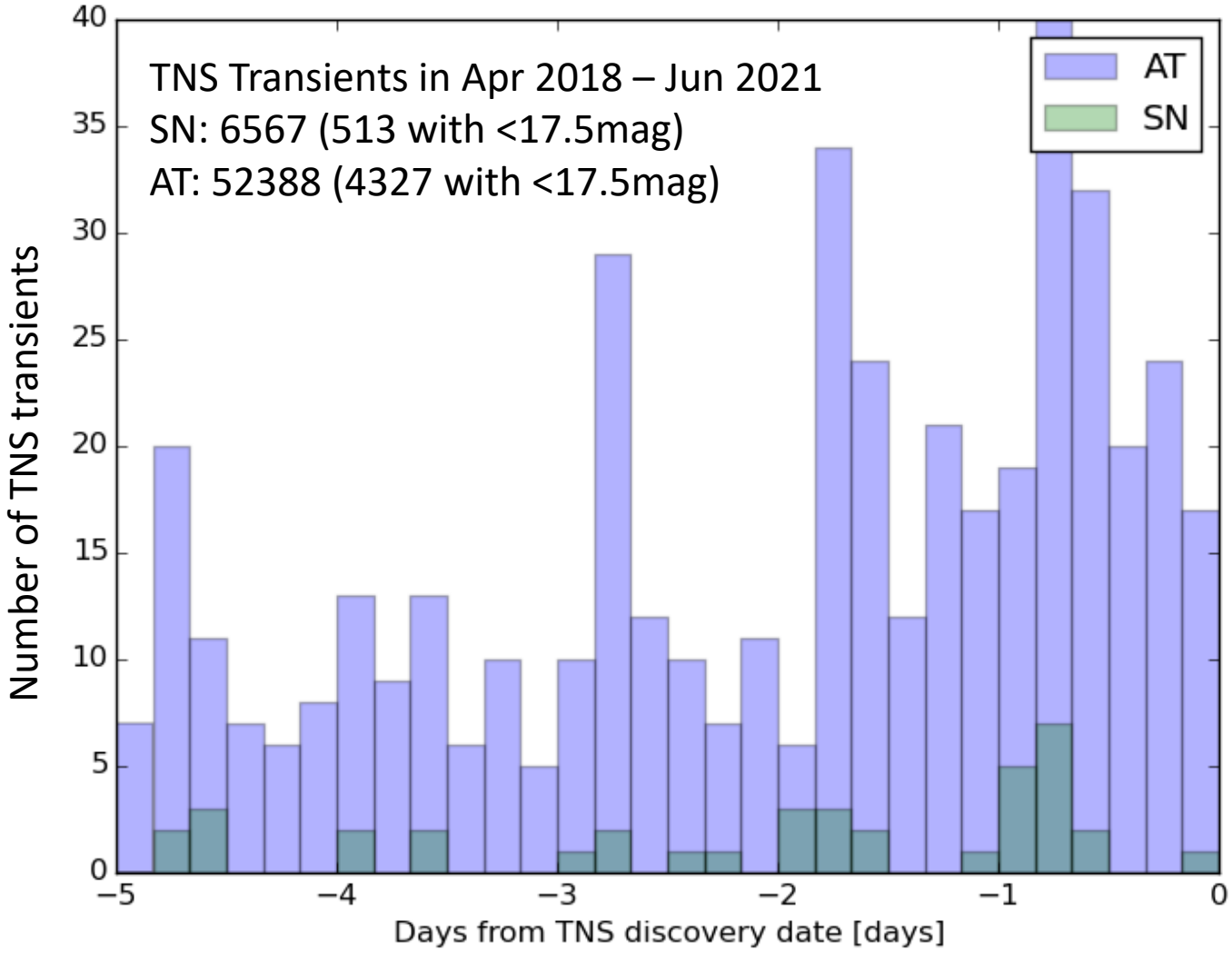
- Machine learning by Takahashi-san

Next talk

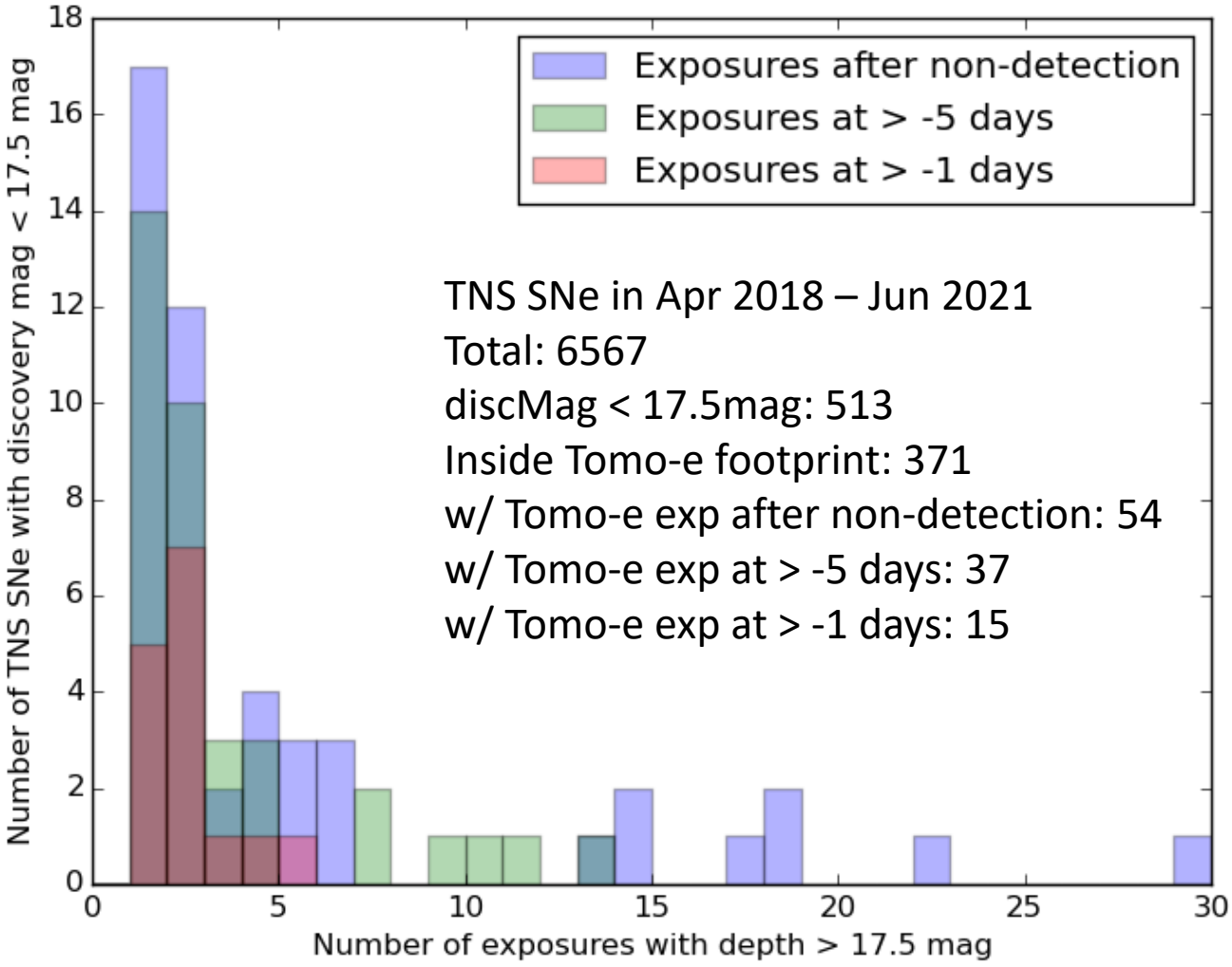
TNS transients



Last date of Tomo-e exposure w/ depth > 17.5mag before discoveries of TNS transients w/ < 17.5mag



Number of TNS SNe with discMag < 17.5mag and number of Tomo-e exposures with depth > 17.5mag before discoveries



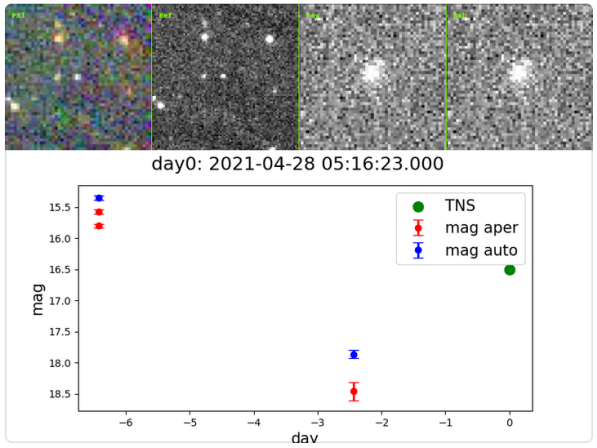
TNS transient alerts @transient_alarm

SN bot アプリ 03:27

Discovery before TNS discDate @channel

TNS name: AT 2021koz
TNS URL: https://wis-tns.weizmann.ac.il/object/2021koz
TNS DiscDate: 2021-04-28 05:16:23
TNS DiscMag: 16.50
Tomo-e URL: https://tomoe.mtk.ioa.s.u-tokyo.ac.jp/tomoesn/objectTNS.php?tns_name=2021koz
Num. detection (before TNS discDate): 2
MAG (at max S/N): 15.35 (29.77) (-6.42days)
coord: (319.14346, -1.88686) (21h16m34.43s -01d53m12.7s)
Tomo-e name: None
Tomo-e Discovery: 2021-04-25 18:43:39.893 (-2.44days)
first Detection: 2021-04-21 19:05:18.948
Transient URL: https://tomoe.mtk.ioa.s.u-tokyo.ac.jp/tomoesn/object.php?transient_id=7331617
transient ID: 7331617
cnncand (paramcand): 2 (2)

New transient: AT 2021koz



- Discovery
  - Tomo-e discovered the transient with 2 detection
- Detection
  - Tomo-e detected the transient with ML screening
- Positive
  - Forced photometry of Tomo-e difference image is positive.

Future updates

- **Automatic alerts & (automatic) ToO observation**
  - Oct 30-31: Visit to Seimei
  - Auto-generation of ToO commands
  - Quality assessment by us
  - ToO observation by observers

  - Automatic alerts
  - (Automatic) ToO observation

Summary

- Tomo-e is observing 12000deg2 every night and 3000deg2 with high cadence.
- Transient pipeline is now realtime.
- Web interface, reference images, and machine learning are improved.
- Tomo-e observed several TNS transients before the discovery reports. New students at SOKENDAI and Tohoku Univ. will contribute.
- Please register transient_alarm channel.
- Continuing efforts to realize automatic alerts & ToO.