Caltech

The Zwicky Transient Facility Bright Transient Survey:

An Unbiased View of the Transient Sky

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Kirsty Taggart (LJMU), Melissa Graham (Washington), Jakob Nordin (Humboldt), Alison Dugas (Hawaii), Rachel Bruch, Steve Schulze, Ido Irani, Erez Zimmerman (Weizmann),
Kishore Patra, Shaunak Modak, Andrew Hoffman, Alex Filippenko (UCB),
Jannis Necker, Ludwig Rauch, Samantha Goldwasser (DESY)

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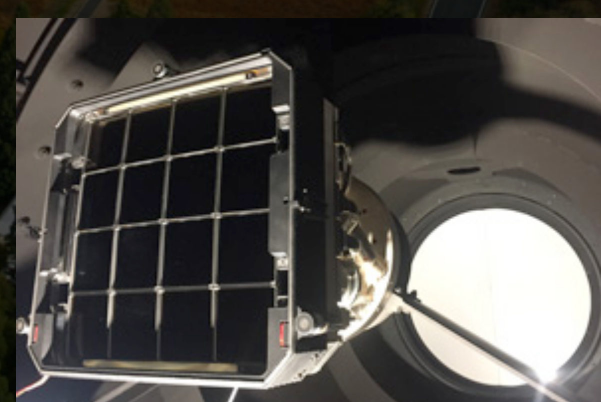
The ZTF Bright Transient Survey BTS

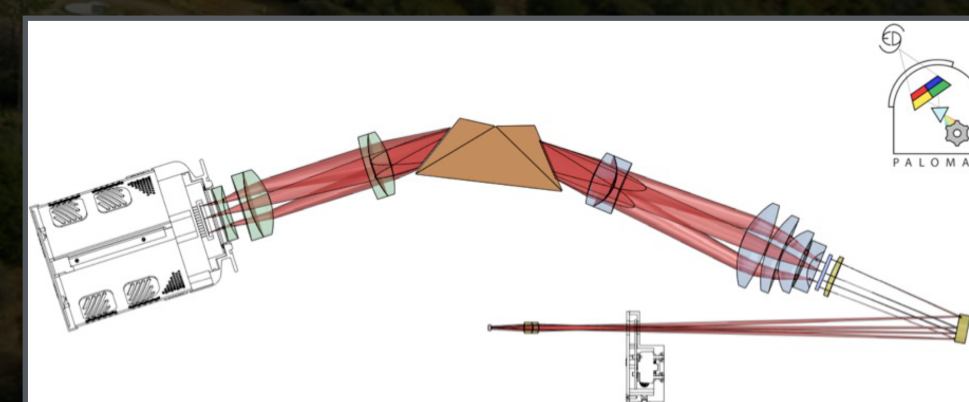
Magnitude limited survey, spectroscopically complete to 18.5 mag.

1. Catalog all SN candidates < 19 mag and send to the Transient Name Server
2. Classify all <18.5 mag SNe using mainly Palomar 60 inch with SEDM

Data from the public ZTF Northern Sky Survey

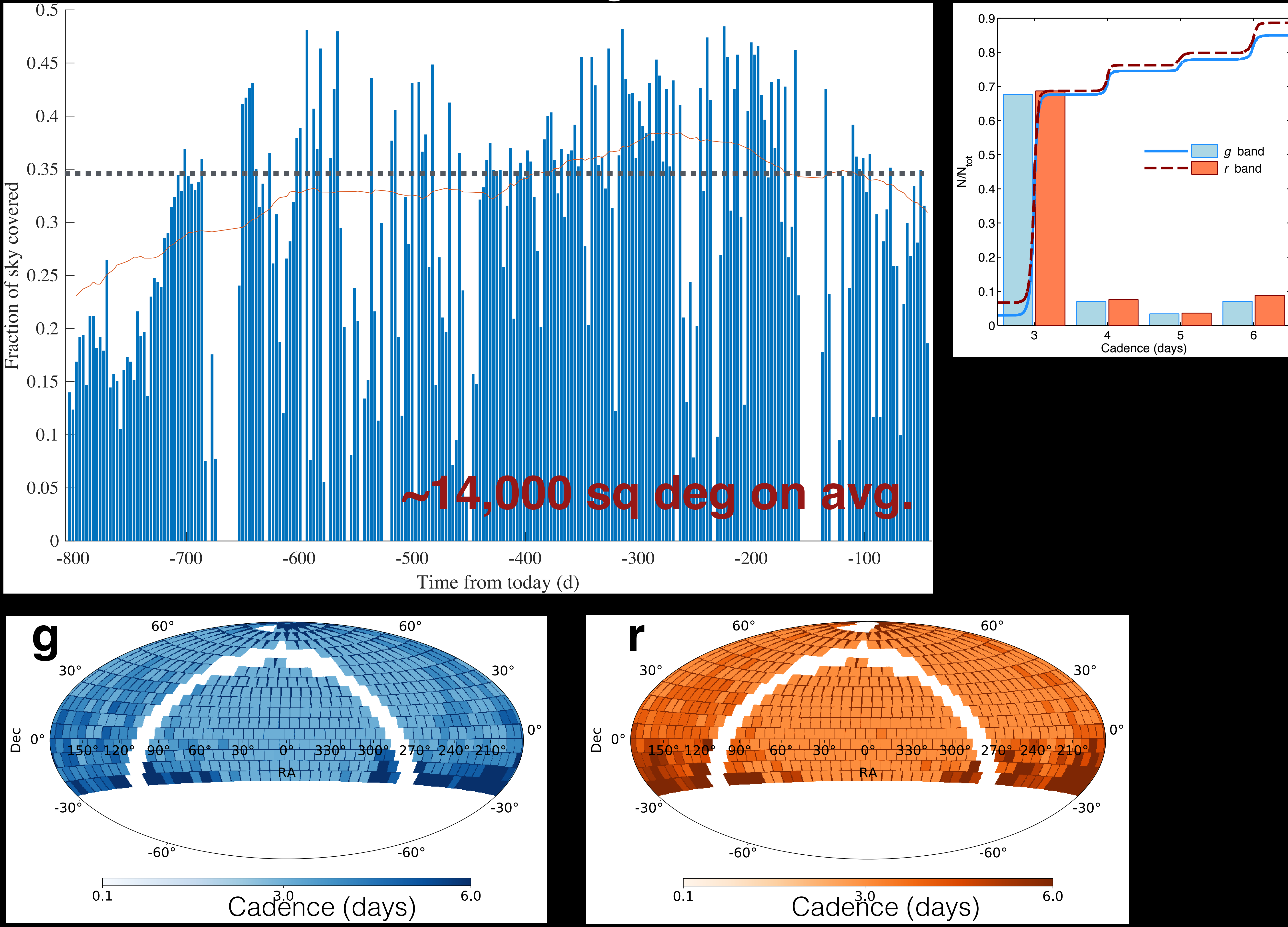
("Celestial Cinematography"; Bellm & Kulkarni, 2017, Nature Astronomy 1, 71)





ZTF-I: 3d cadence, in g & r filters. **ZTF-II: 2d cadence!**

3d-cadence coverage of the ZTF-I NSS



ZTF-II Northern Sky Survey

2-Day Cadence MSIP Survey Performance (2020-10-01 to 2020-10-18)

Area covered in 2 days on average

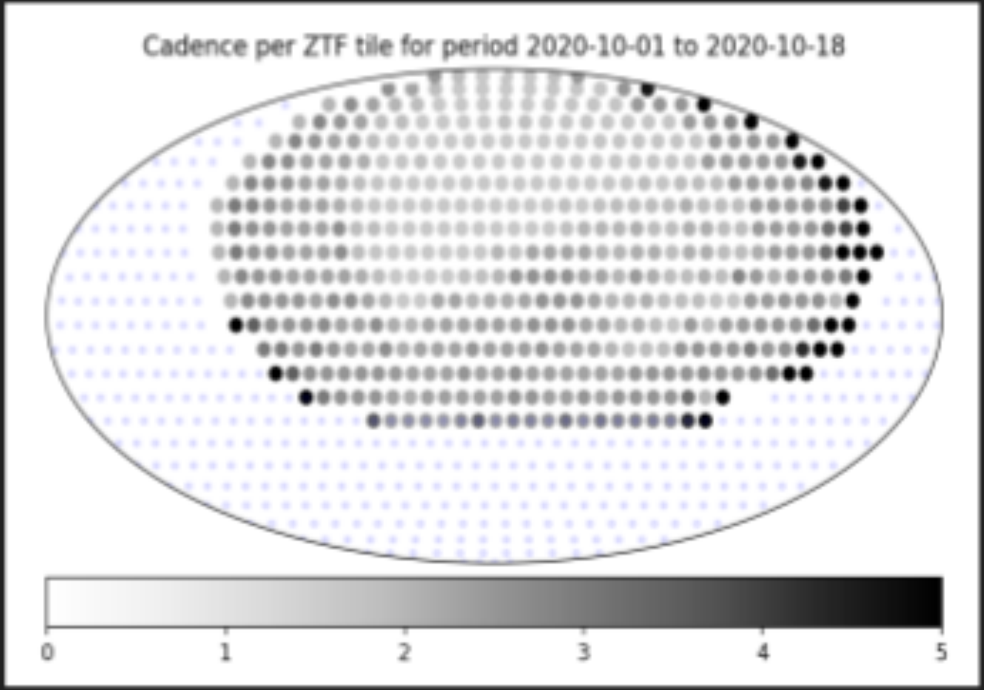
16408 (g) sq. deg

16303 (r) sq. deg

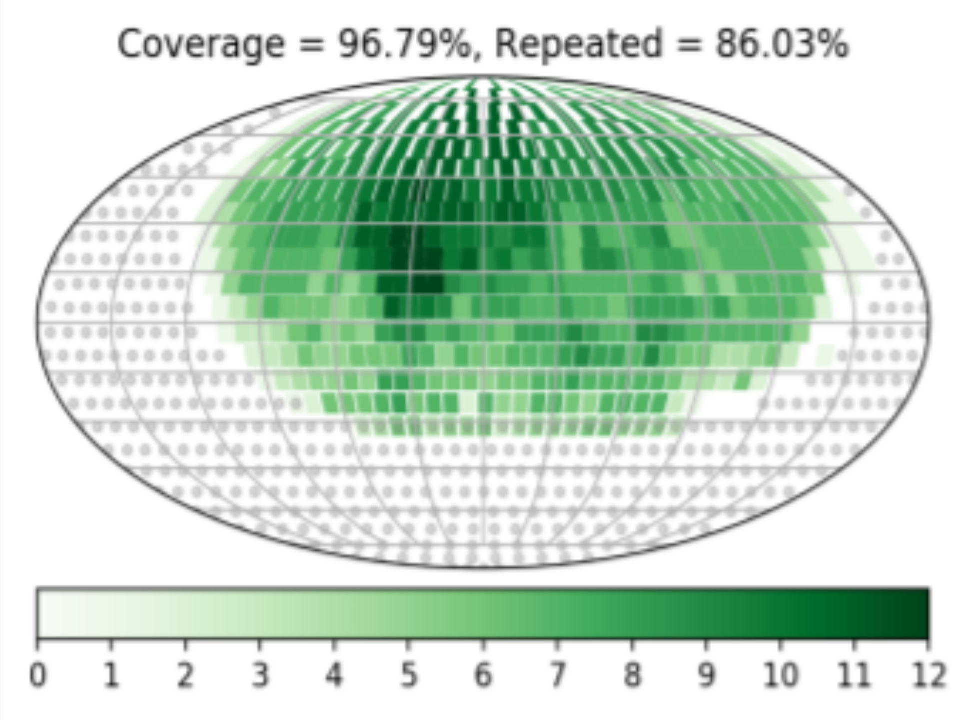
(~75% of visible)

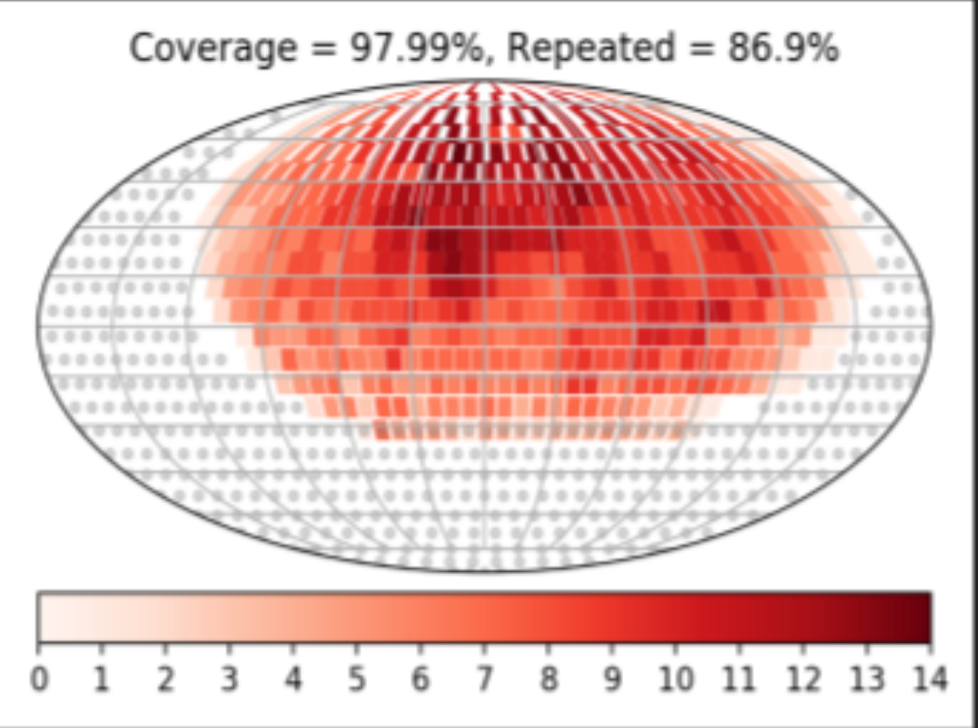
% fields repeated in 2 days on average

2% (g), 9% (r)

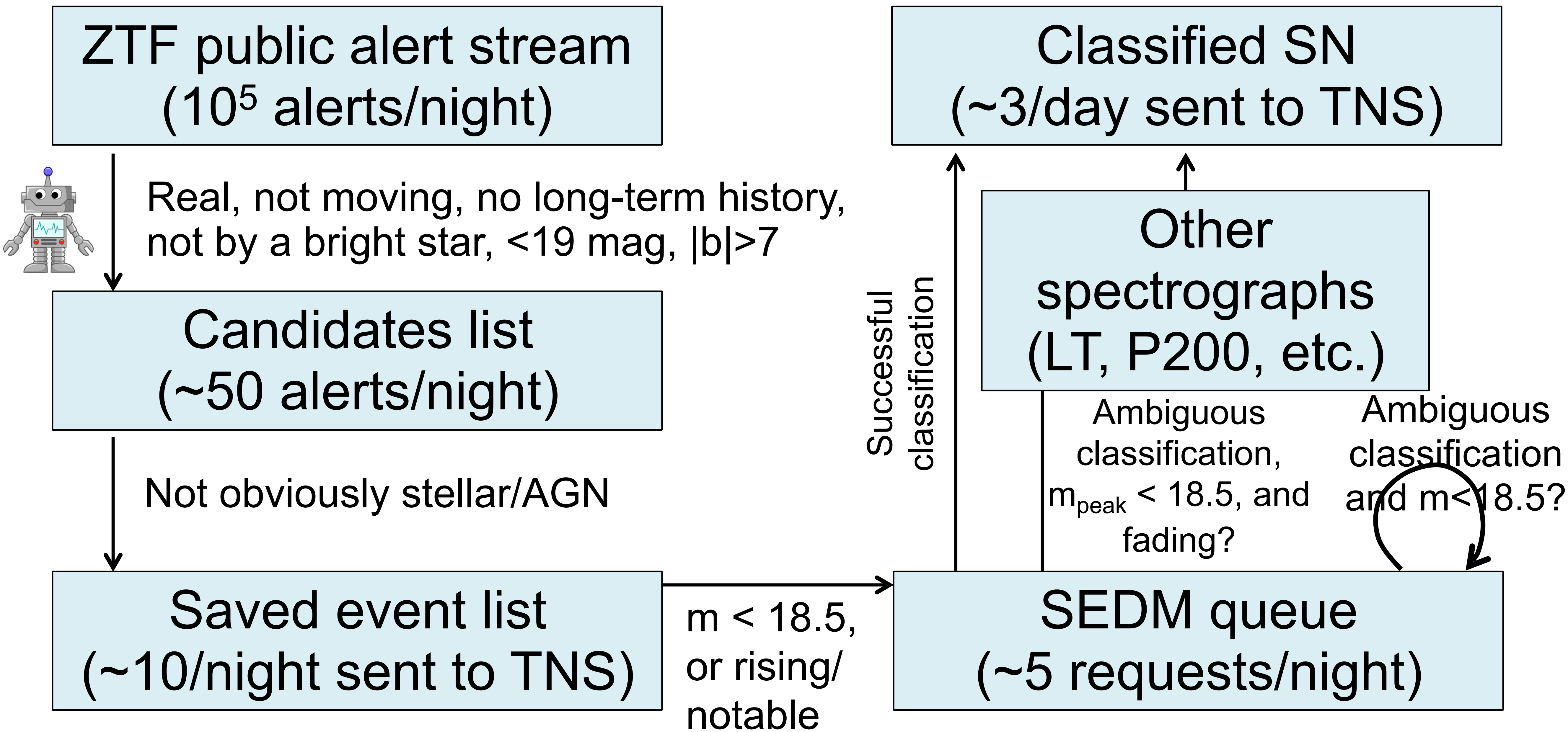


Cumulative coverage maps in g and r bands





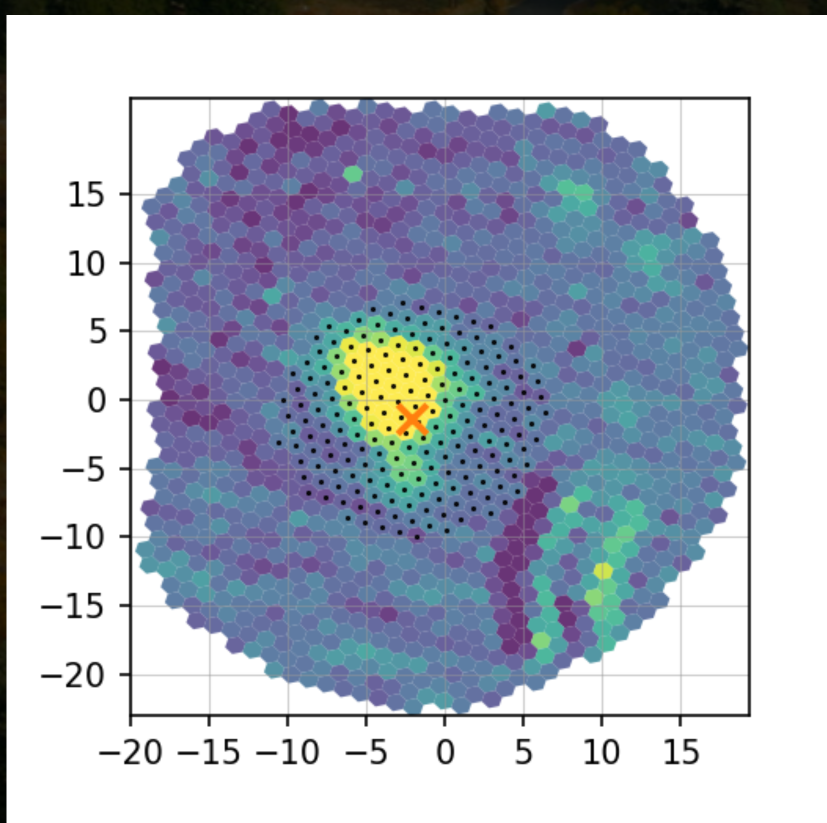
BTS in Practice

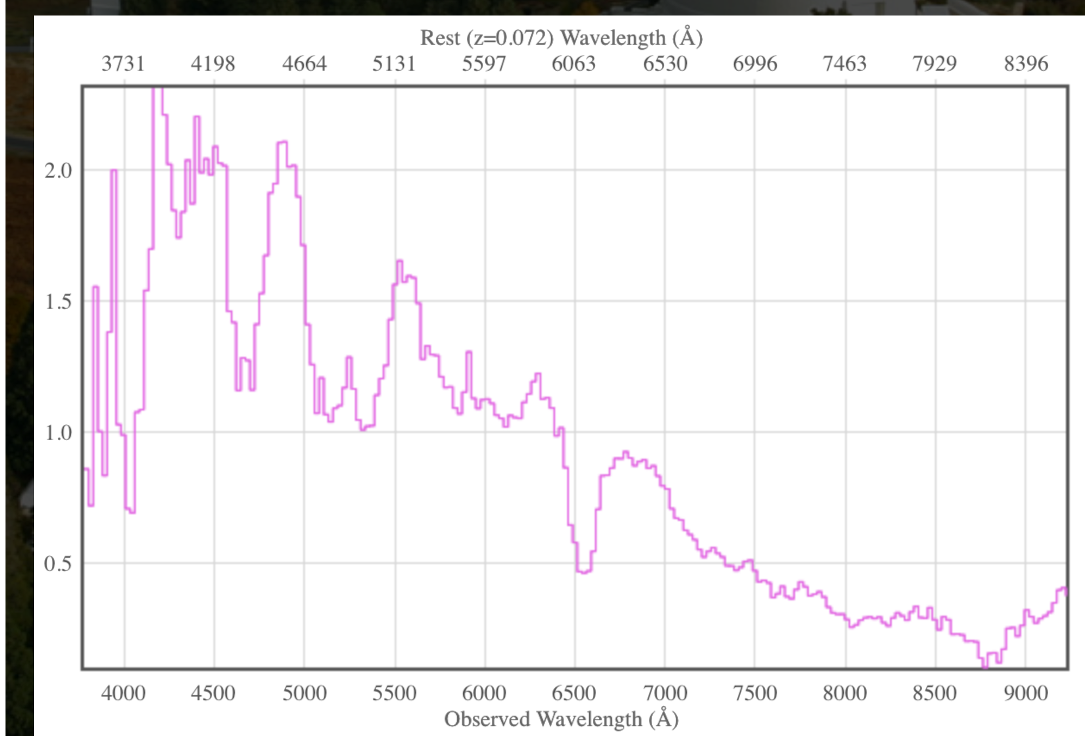


The ZTF Bright Transient Survey (BTS)

BTS classifications

Goal is to spectroscopically classify all transients brighter than 18.5 mag, using mainly SEDM. Currently we trigger all SN candidates at ~19 mag, with rising priority towards <18.5 mag.



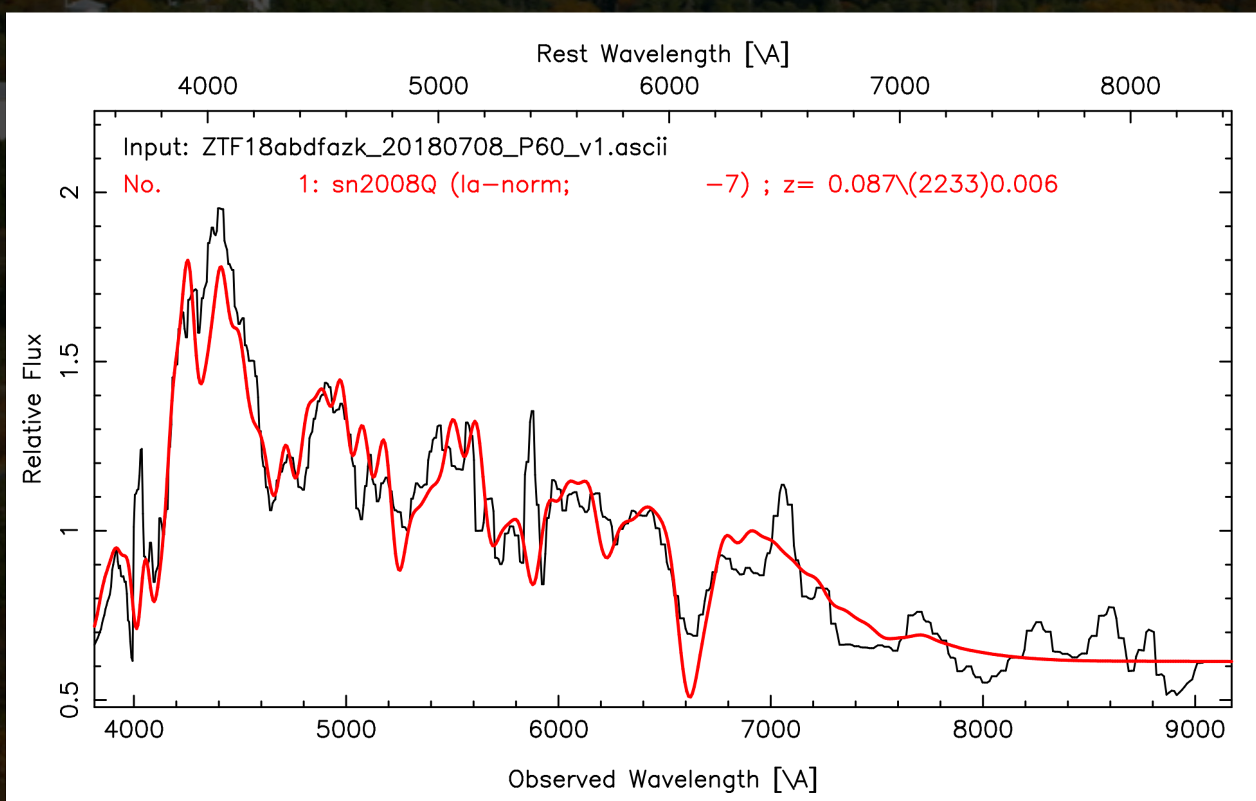


SEDM, 18.5 mag
25 min exp

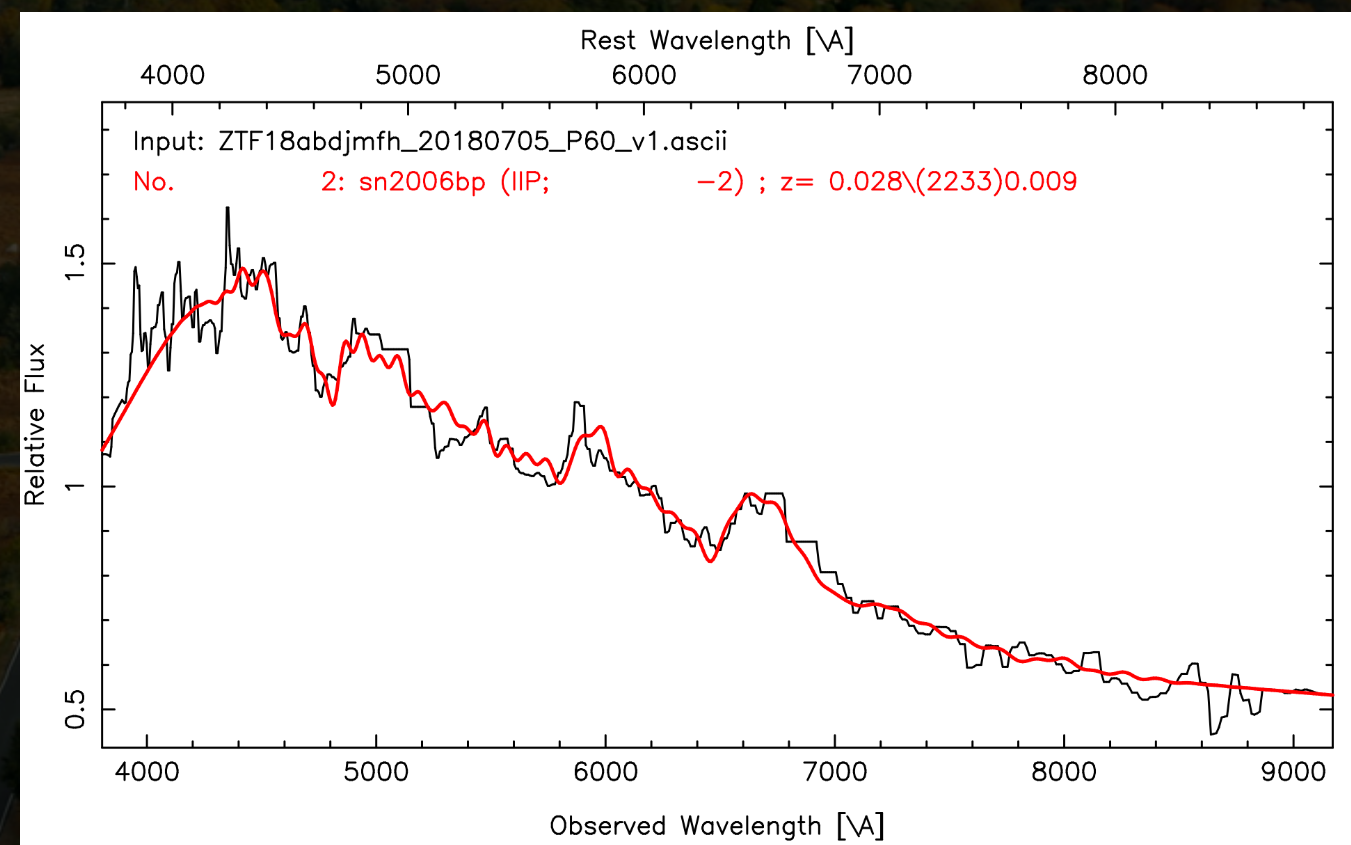
The ZTF Bright Transient Survey (BTS)

SEDM classifications

Based on template matching (e.g., SNID)



SN Ia



SN II

Daily, we publish successful classifications to TNS

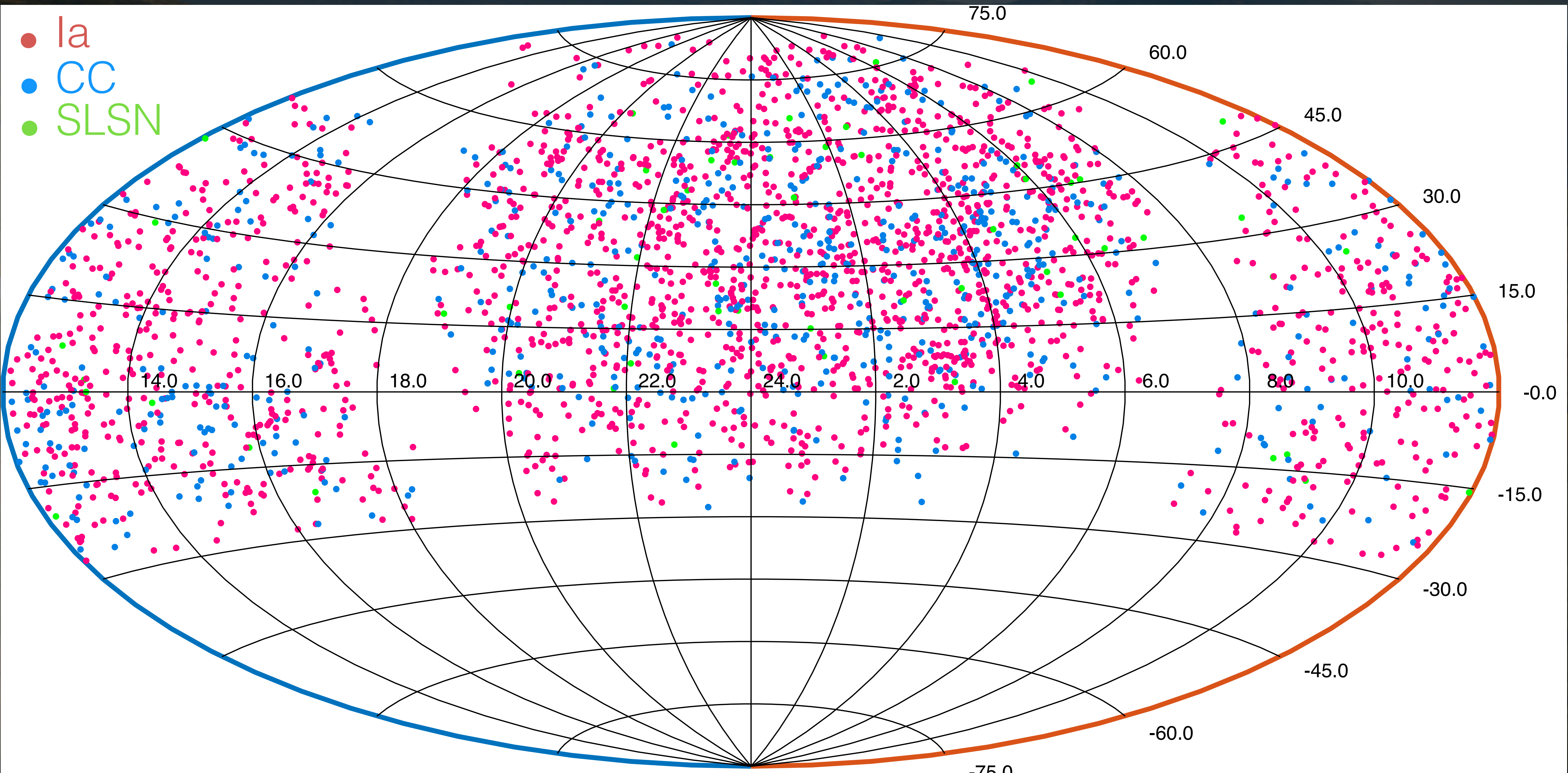
The ZTF Bright Transient Survey (BTS)

BTS classifications

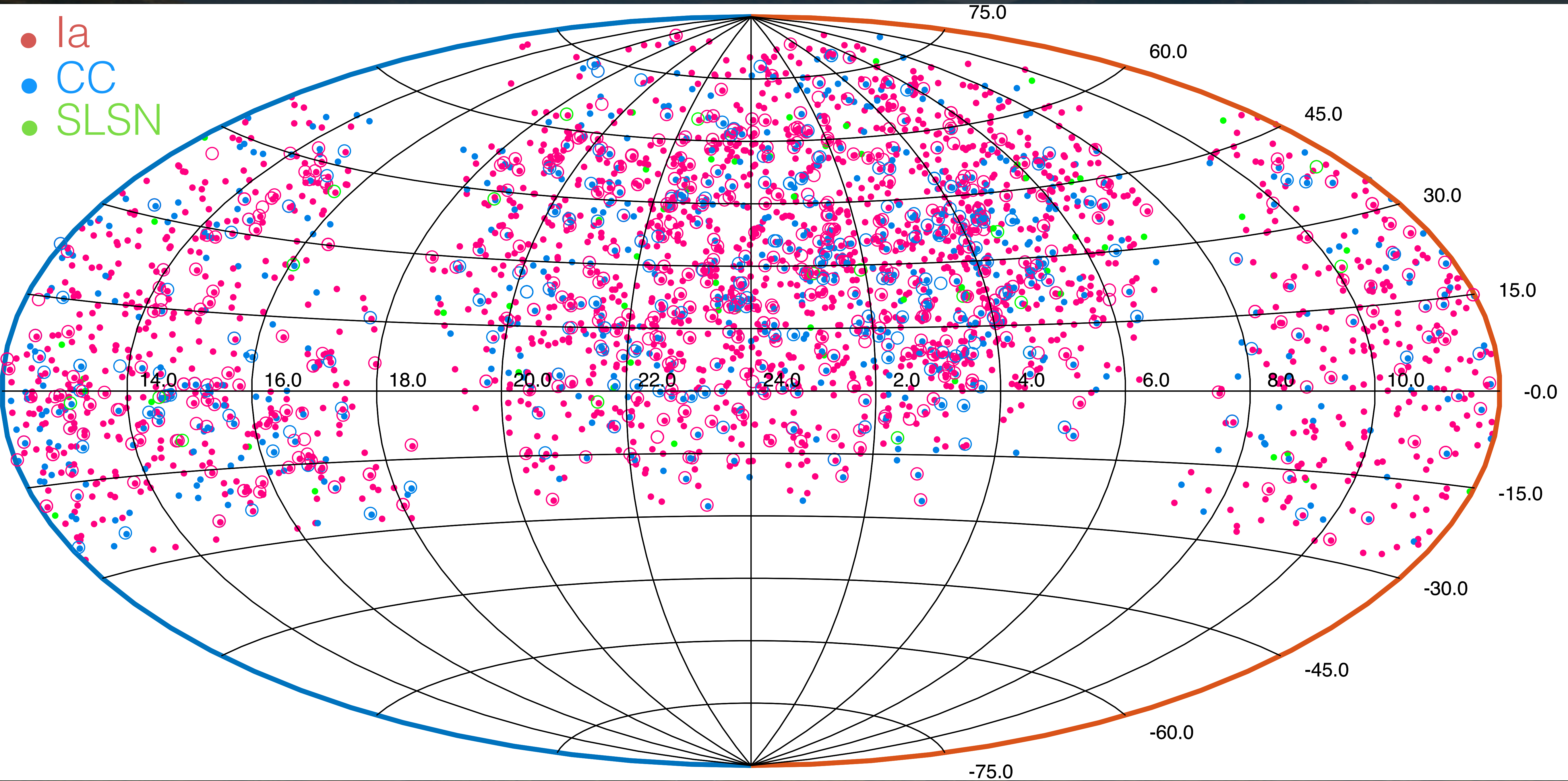
When SEDM fails, we use other facilities — Mainly Palomar 200 inch.

Lick 3m, NOT, LT, APO, Keck, … + community, via TNS.

BTS SN sky positions



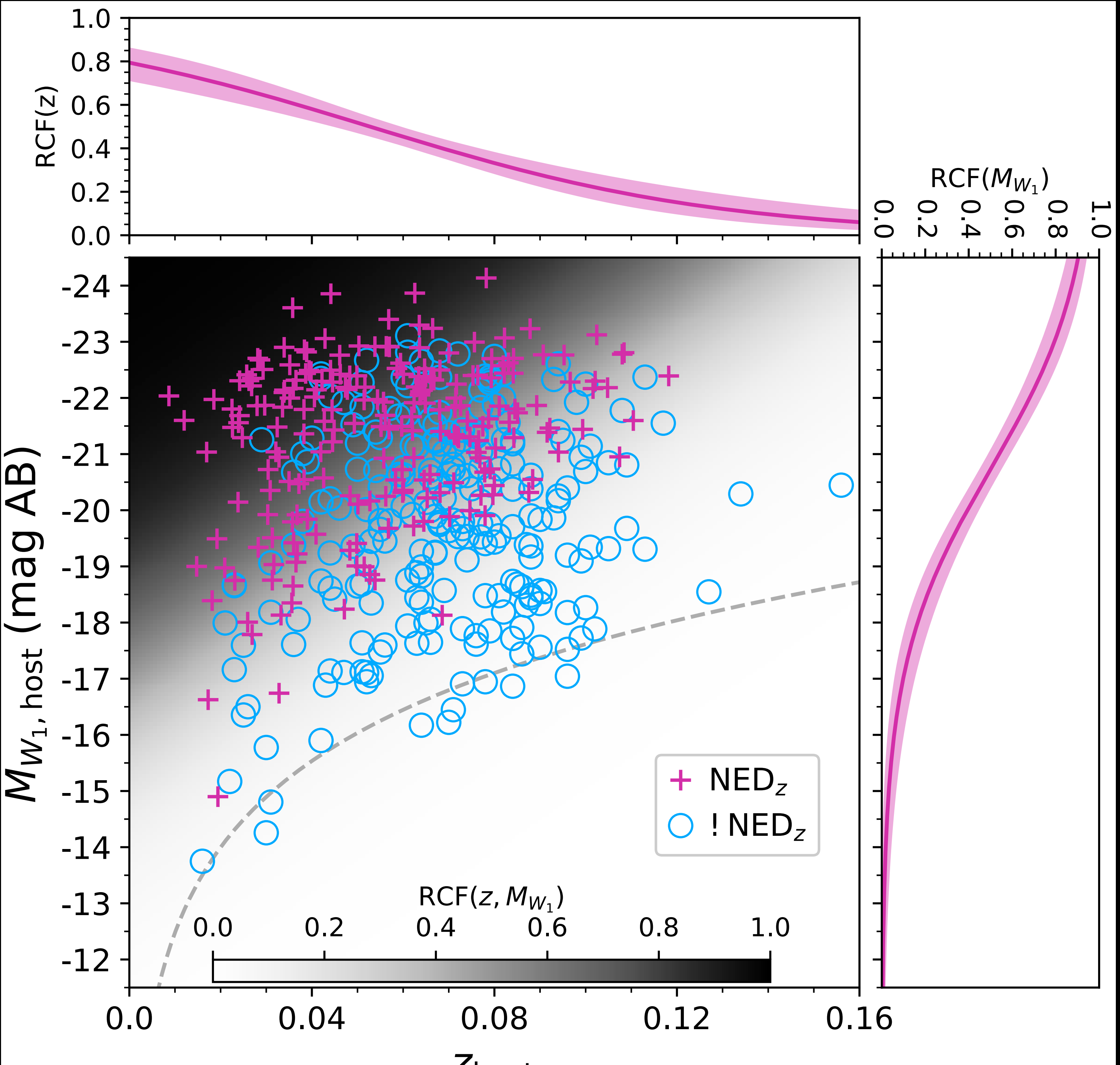
BTS SN sky positions



SNe in galaxies with known redshifts circled.
This is why an untargeted survey is needed!

Redshift completeness of current local galaxy catalogs

RCF ~ 0.6 at 200 Mpc



Fremling et al., (2020)

Status of the BTS Sample

Classified Extragalactic Transient Count (2020 Oct)

3687 ex.gal. transients

2610 SN Ia

incl. 10 Iax

209 SN Ib/c

incl. 13 Ibn, 30 Ic-BL, 37 SLSN-I

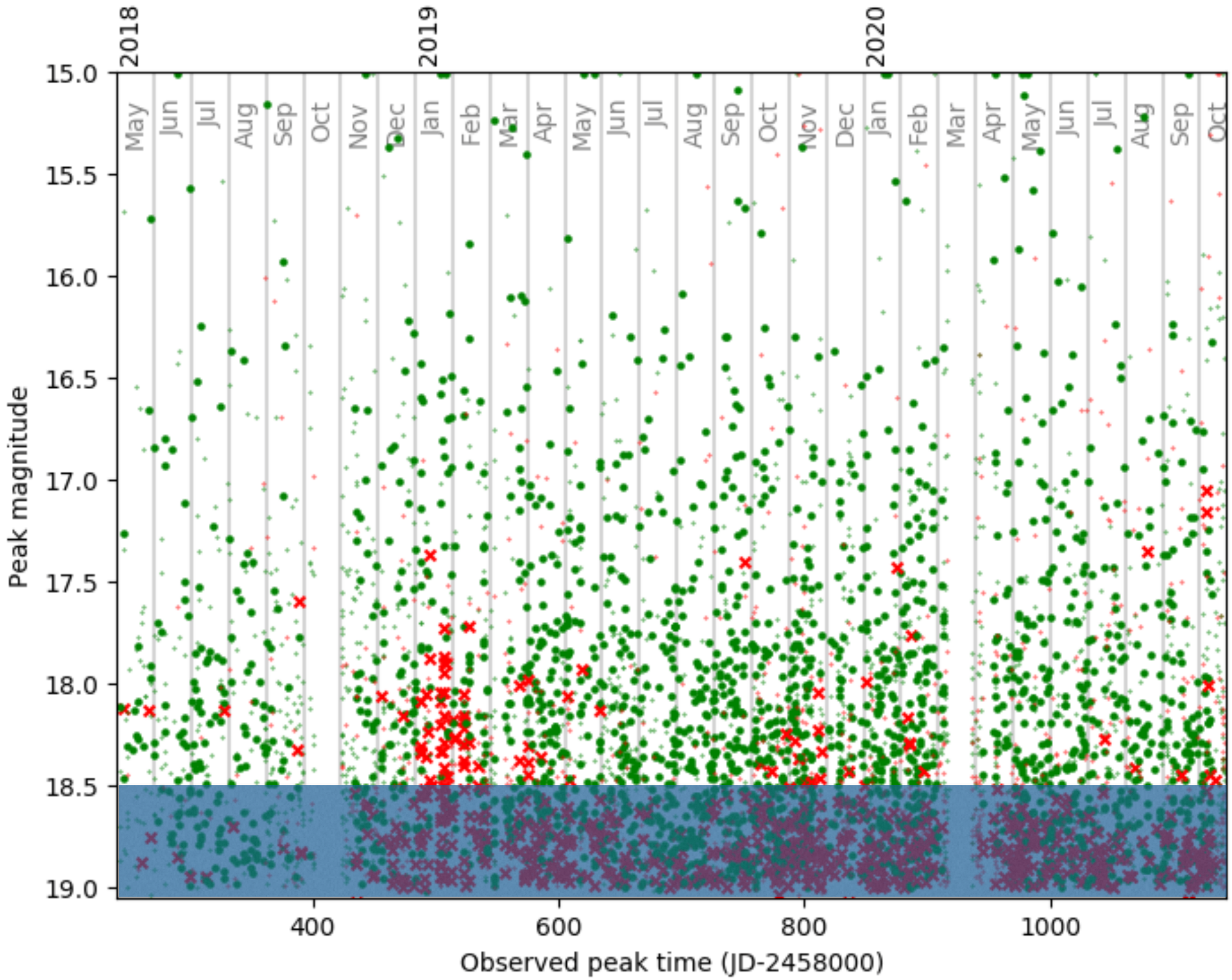
943 SN II

incl. 53 IIb, 104 IIn, 25 SLSN-II

+ 19 TDEs

+ 39 "other" (Gap, Ca-rich, Novae, ILRTs, FBOTs, LBVs)

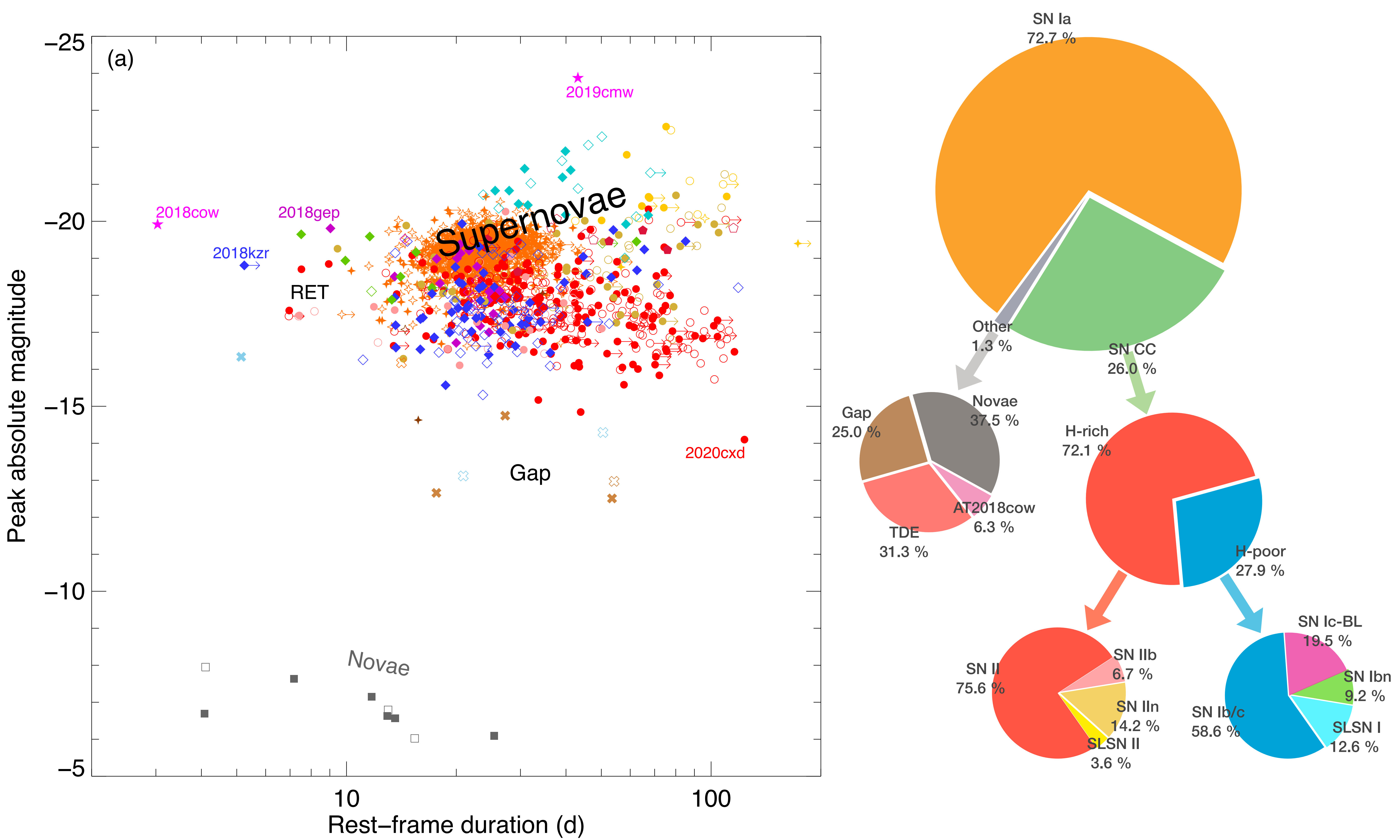
Completeness over time



Average 94%, some months virtually 100%

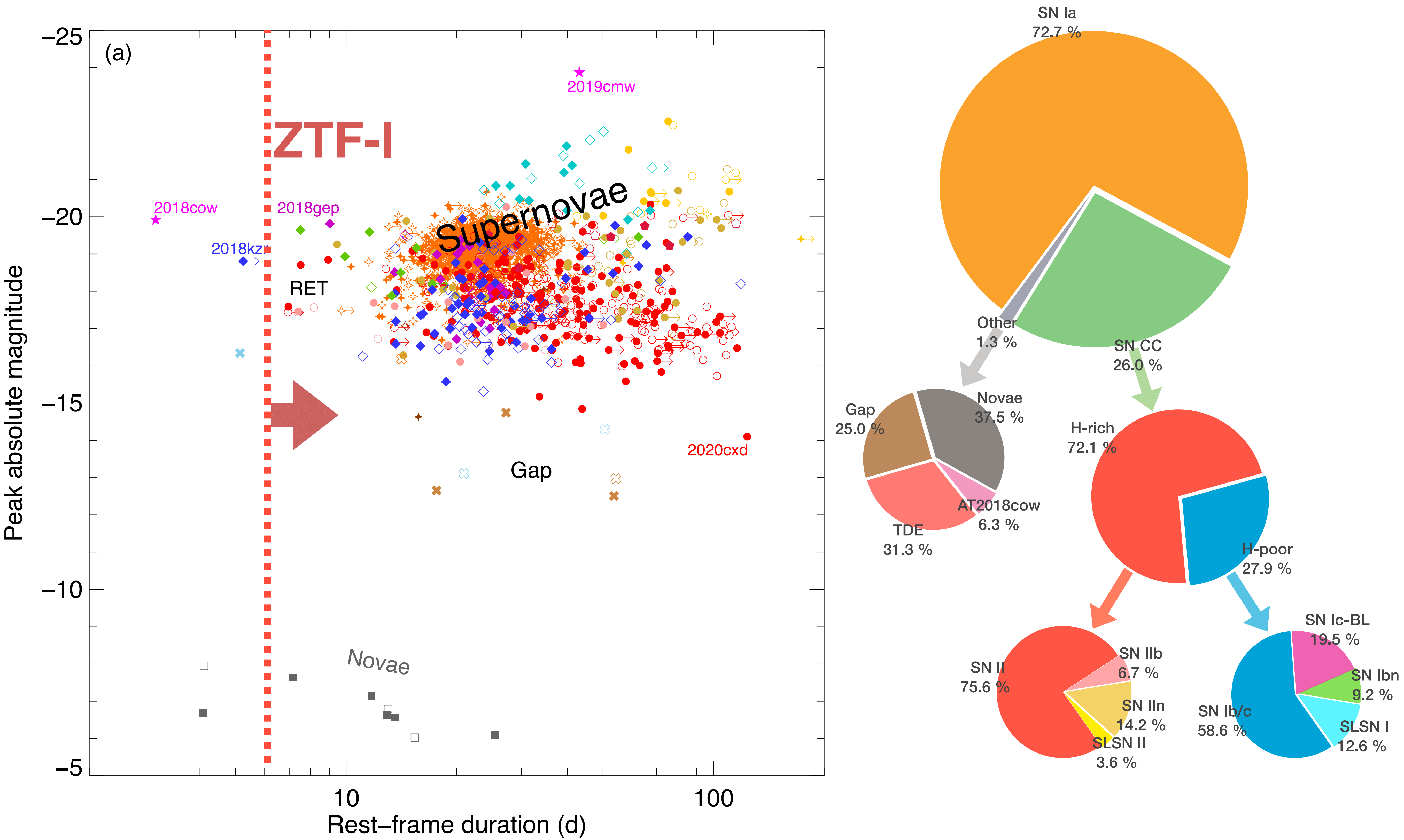
https://sites.astro.caltech.edu/ztf/rcf/rcf/status.php

BTS Transient Lightcurve Parameter Space



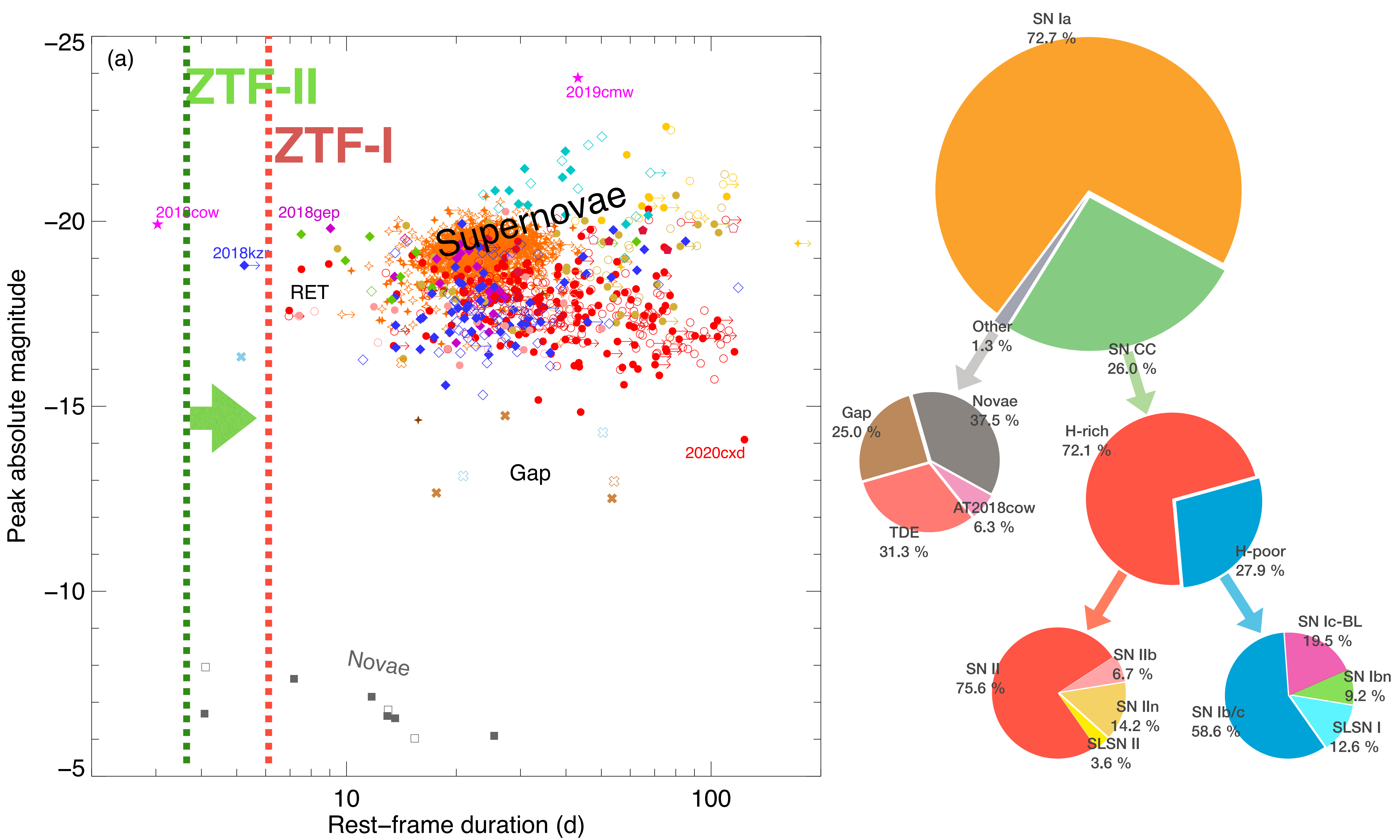
Perley+ 2020

BTS Transient Lightcurve Parameter Space



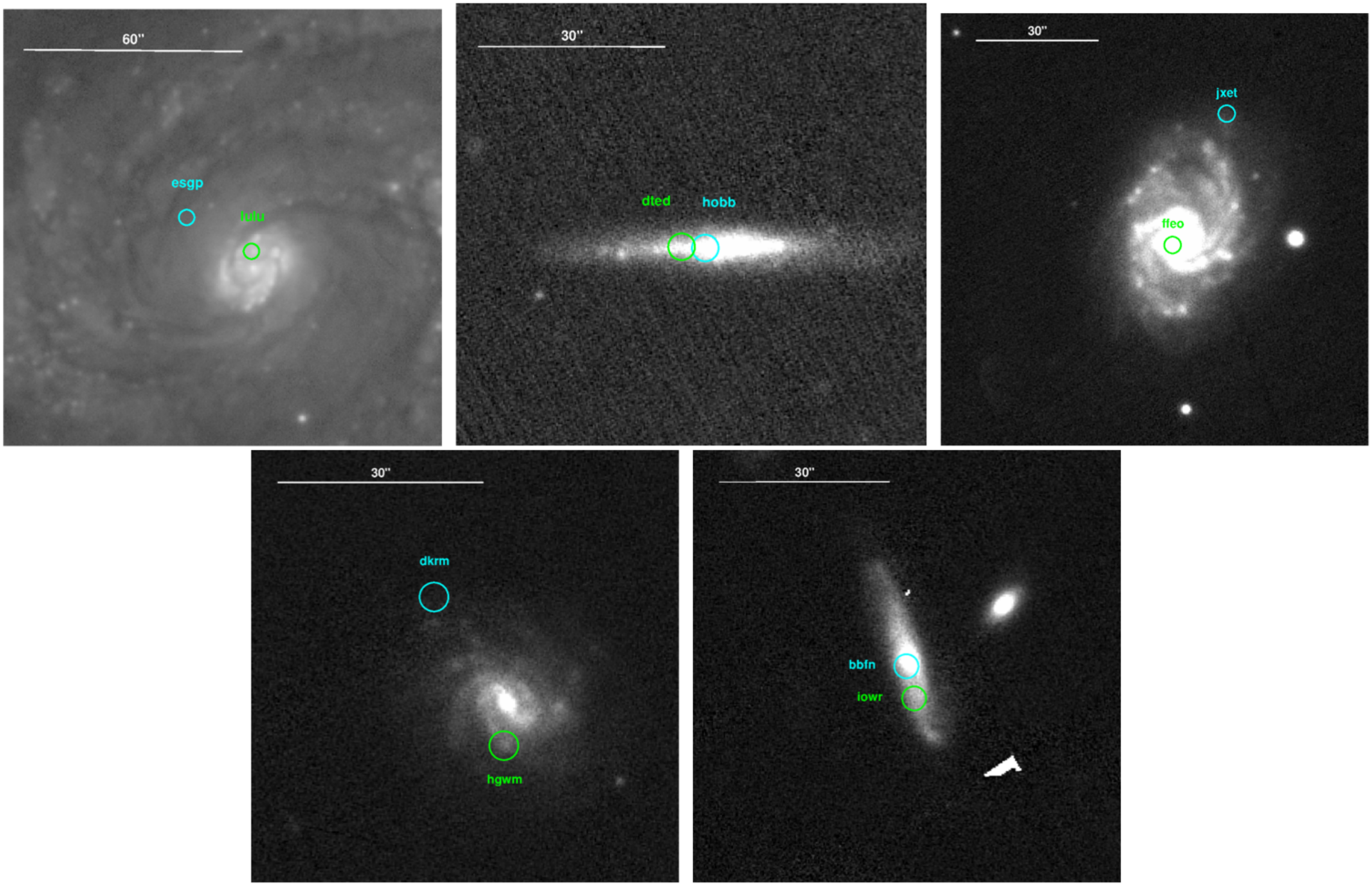
Perley+ 2020

BTS Transient Lightcurve Parameter Space



Perley+ 2020

ZTF-II:
long baseline allows systematic study of SN Siblings

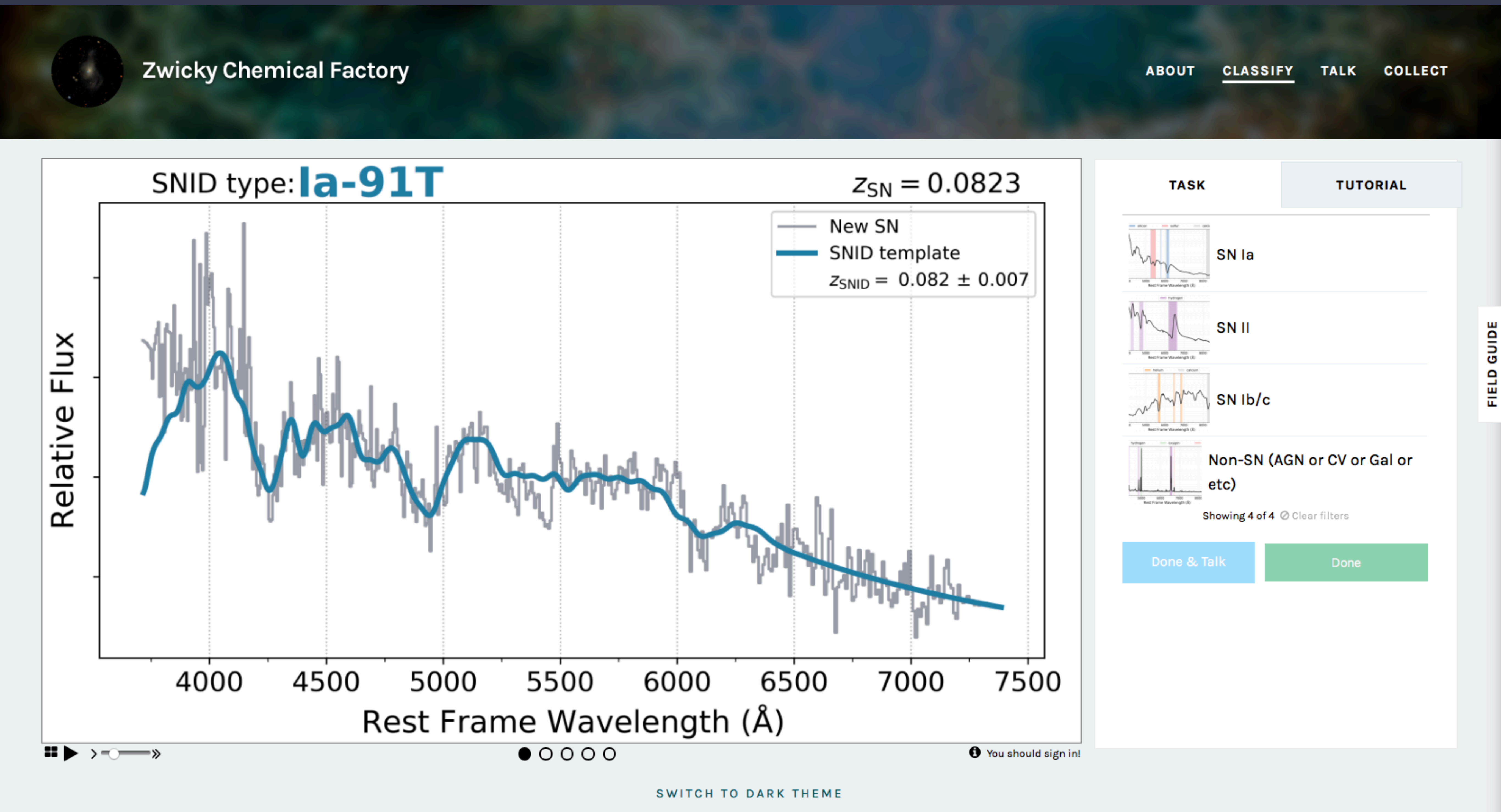


M.L. Graham + in prep

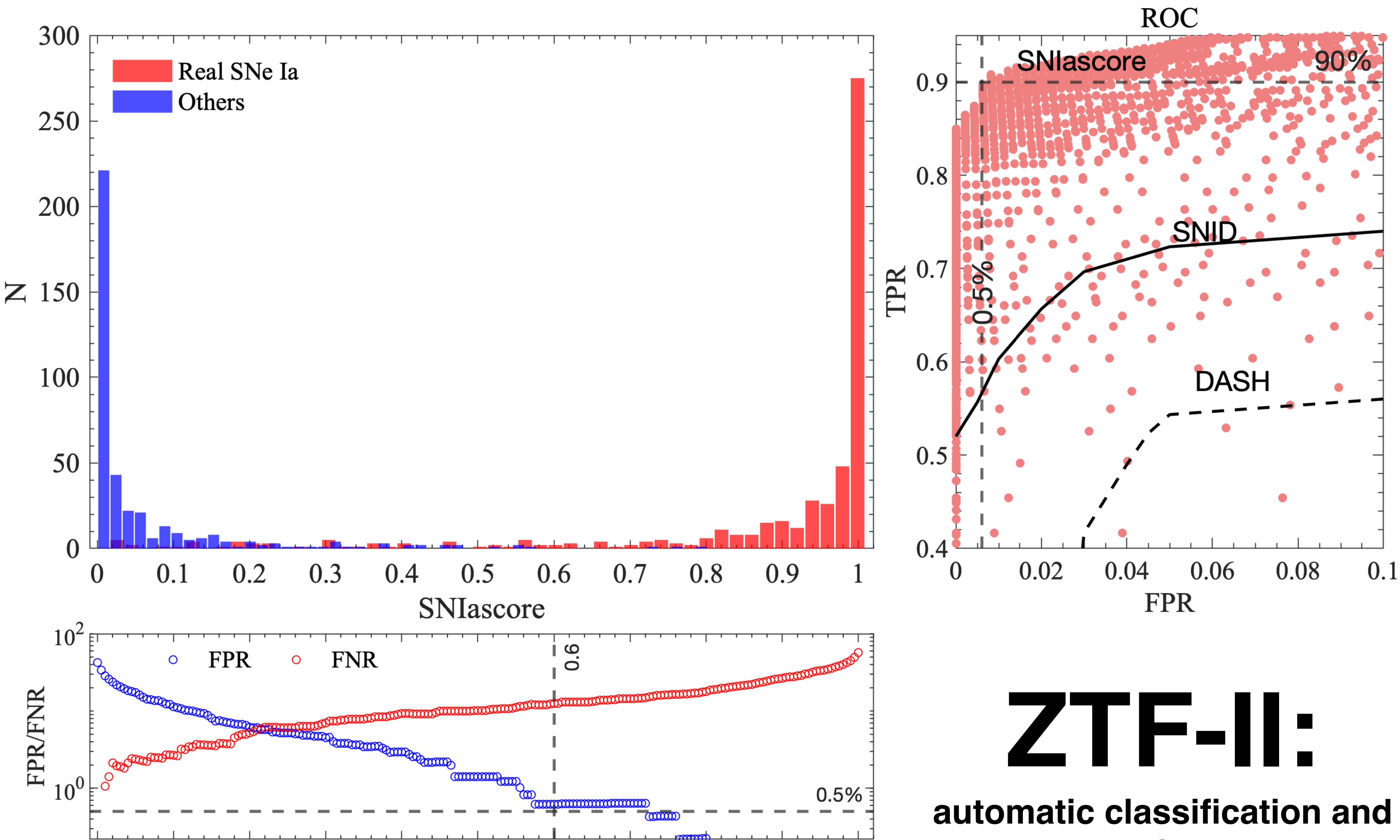
Zwicky Chemical Factory

ZTF-II

Zooniverse-based citizen science project to classify BTS SN spectra
Show users spectrum and best fit
Will be used to provide “final” classifications in ~real time



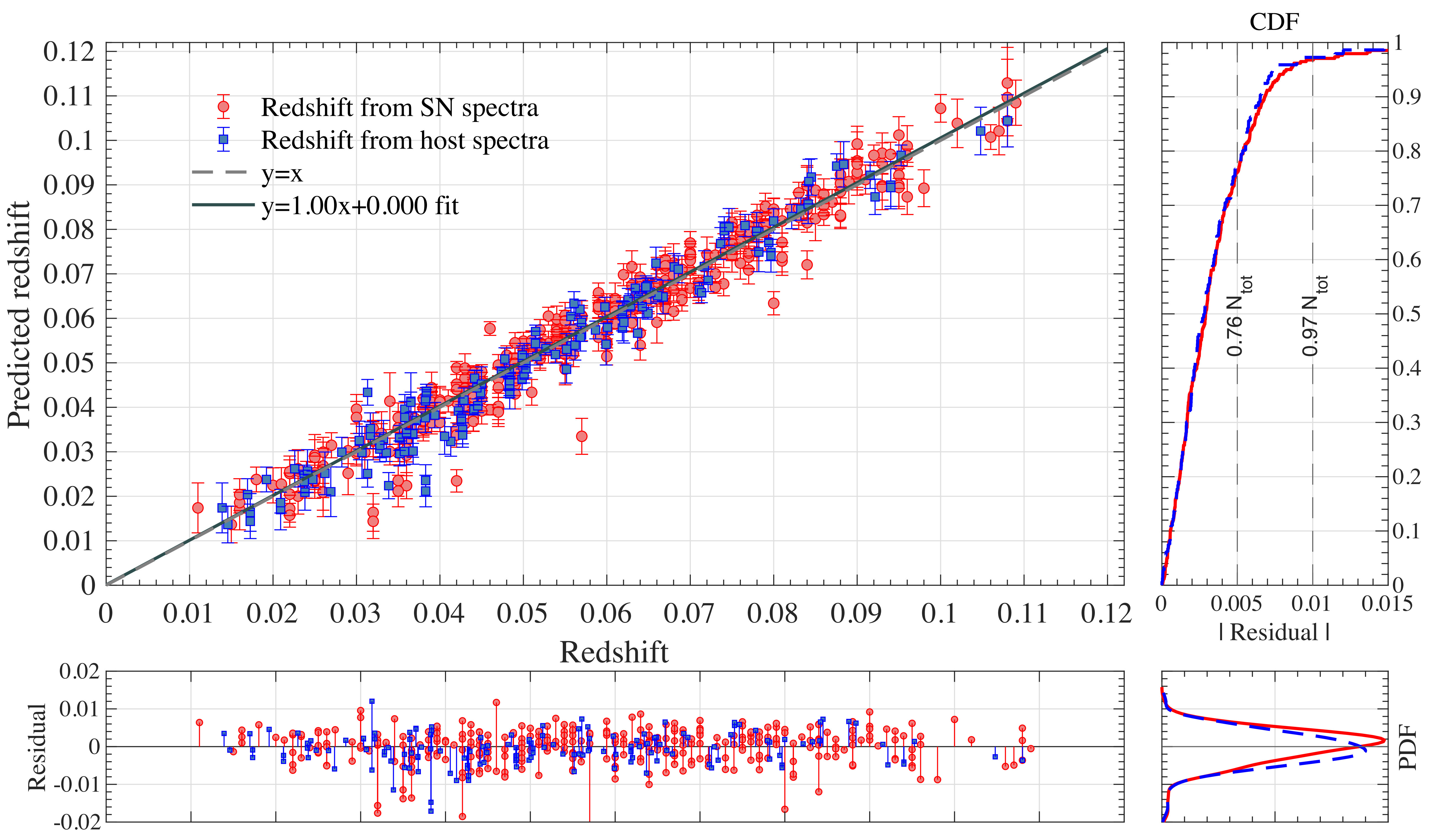
SNIascore, Deep learning SEDM classification, Fremling+ in prep.



ZTF-II:

automatic classification and uploads to TNS without delay

SNIascore, Deep learning SEDM classification, Fremling+ in prep.



BTS Summary

- Highly complete mag limited survey to 18.5 mag
- Enables extragalactic transient demographics: lightcurves and luminosity functions
- Rates
- Host galaxies
- Matter distribution
- Neutrino correlations with SNe
- And much more!