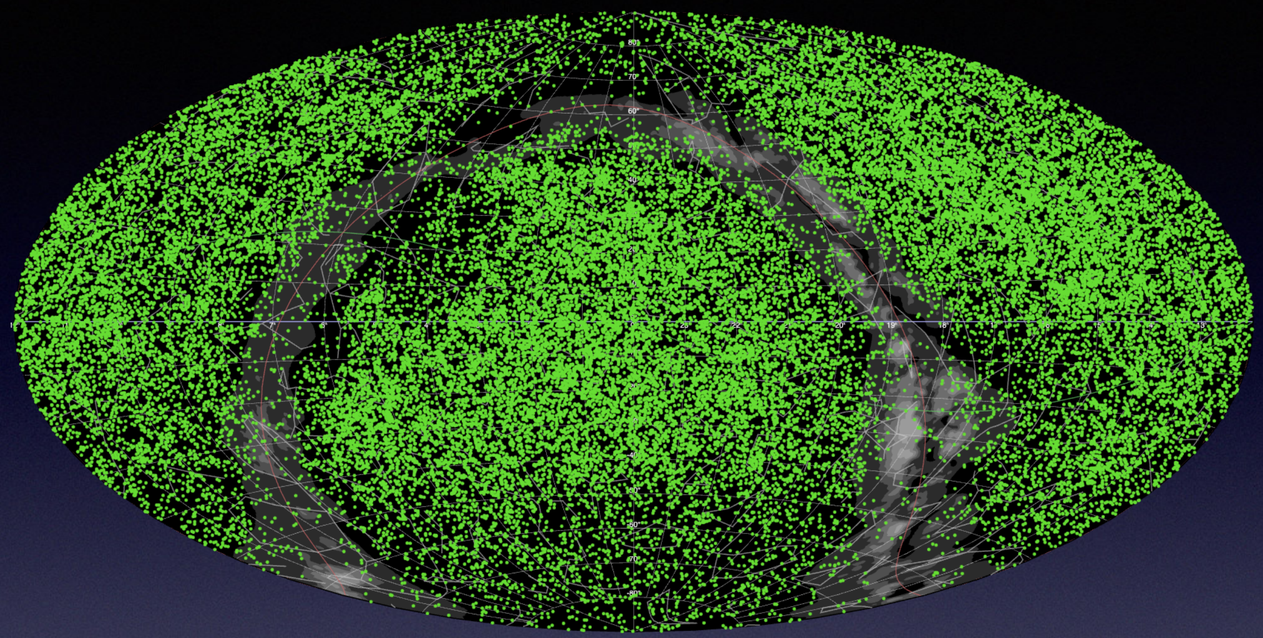
ATLAS Local Volume Survey: overview and preliminary results

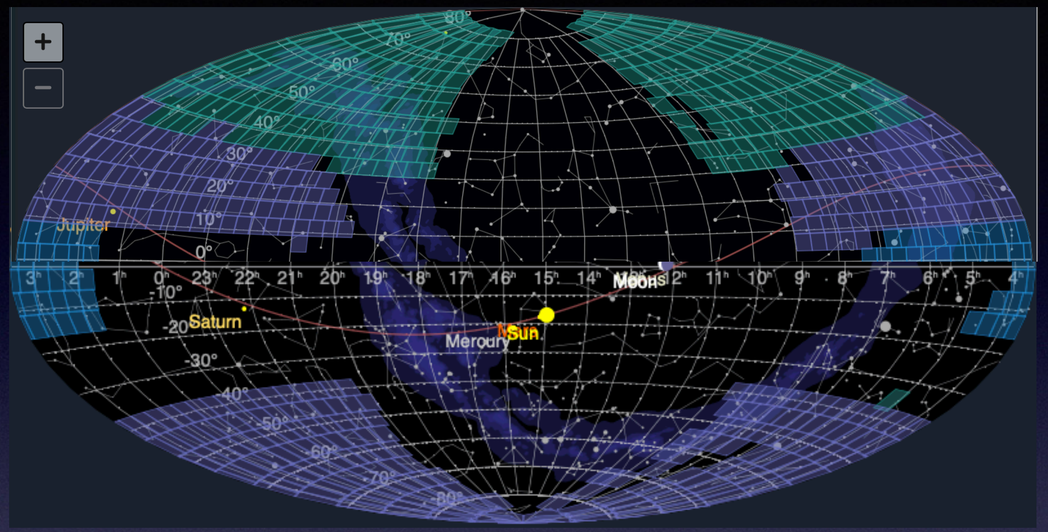
Shubham Srivastav (Oxford)

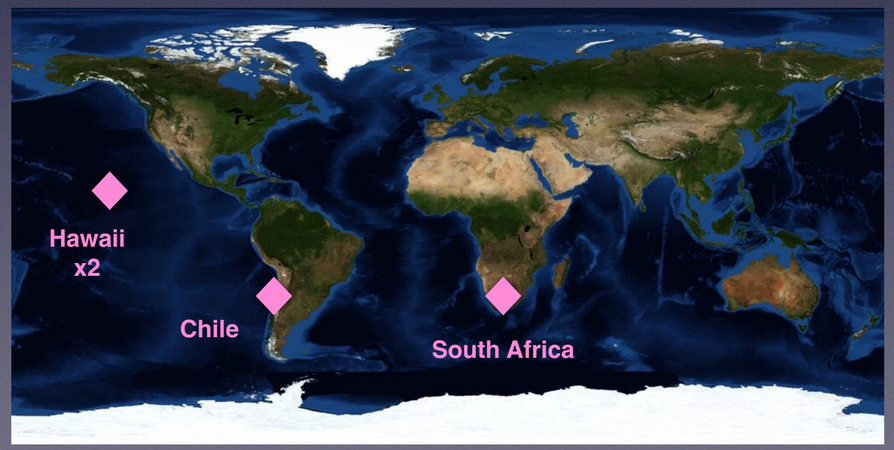
with Oxford, QUB, ATLAS and ePESSTO+ collaborators

An extraordinary journey into the transient sky: from restless progenitors to explosive multi-messenger signals
1-4 April, Padova

ATLAS





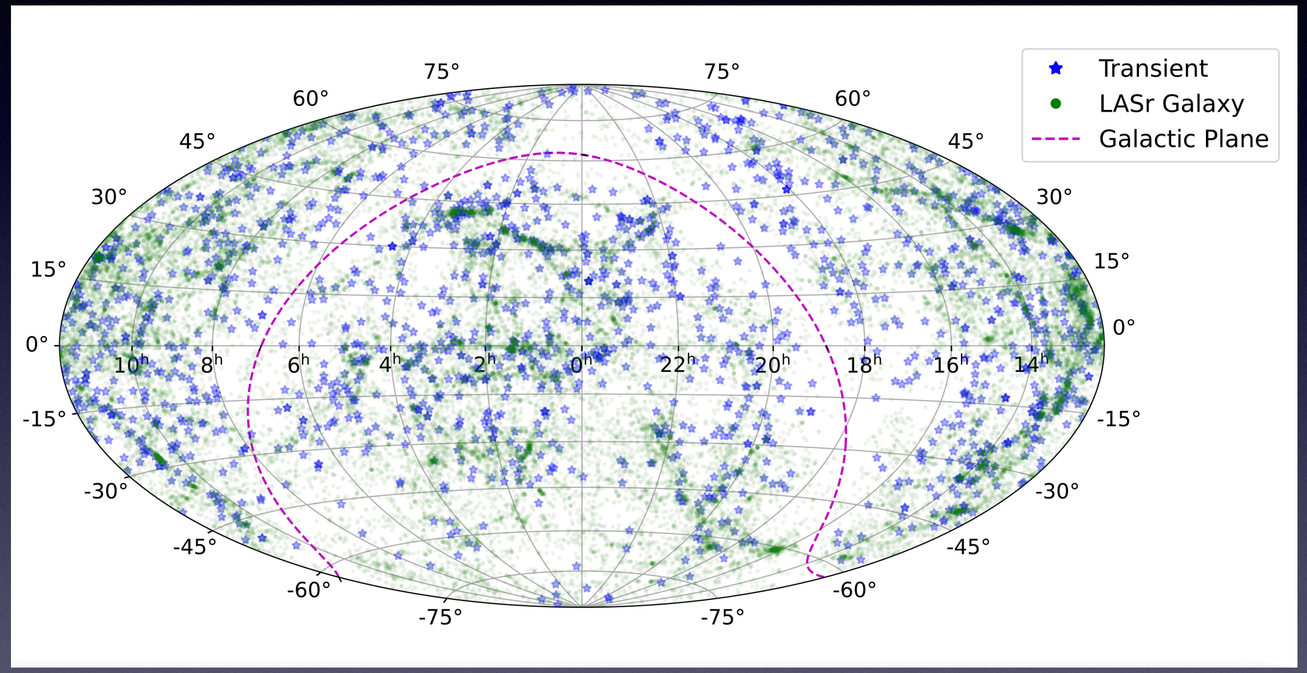


- 4 x 0.5m telescopes, 30 sq deg
- m < 19.5 (5 sigma) in 30 sec
- 4 visits per night
- orange (r+i) & cyan (g+r) bands
- Cadence: 12-36 hours

Tonry et al. 2018, Smith et al. 2020

ATLAS 100 Mpc transient survey

- Transients detected by ATLAS within $z \leq 0.025$ during 2017-09-21 to 2023-06-21
- Sherlock (Dave Young) crossmatch radius: 50 kpc
- Include transients classified on TNS with object z within 0.025
- Remove contaminants
- 1700+ objects, sample complete to $M \sim -16$



Srivastav+ in prep

Contaminants and Completeness

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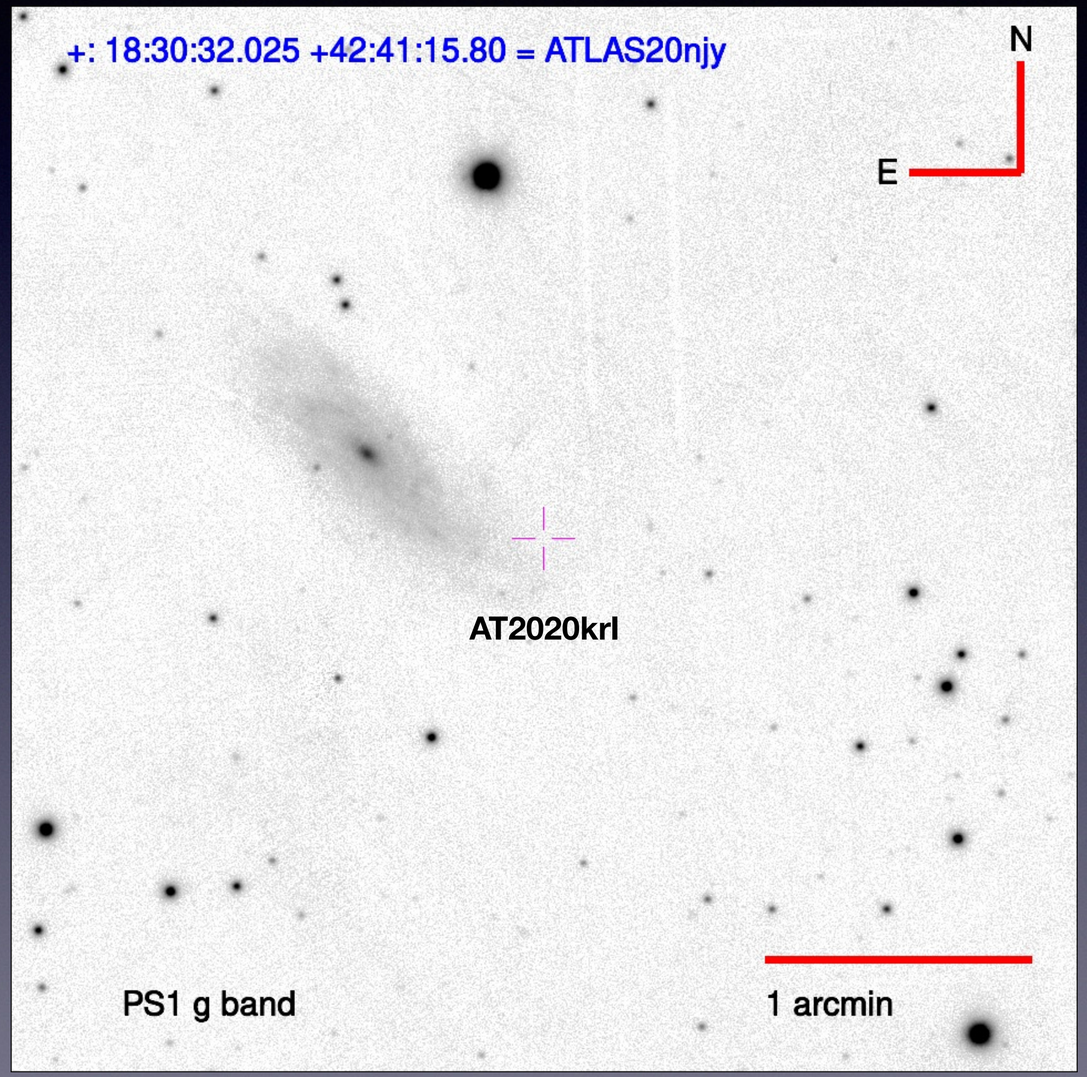

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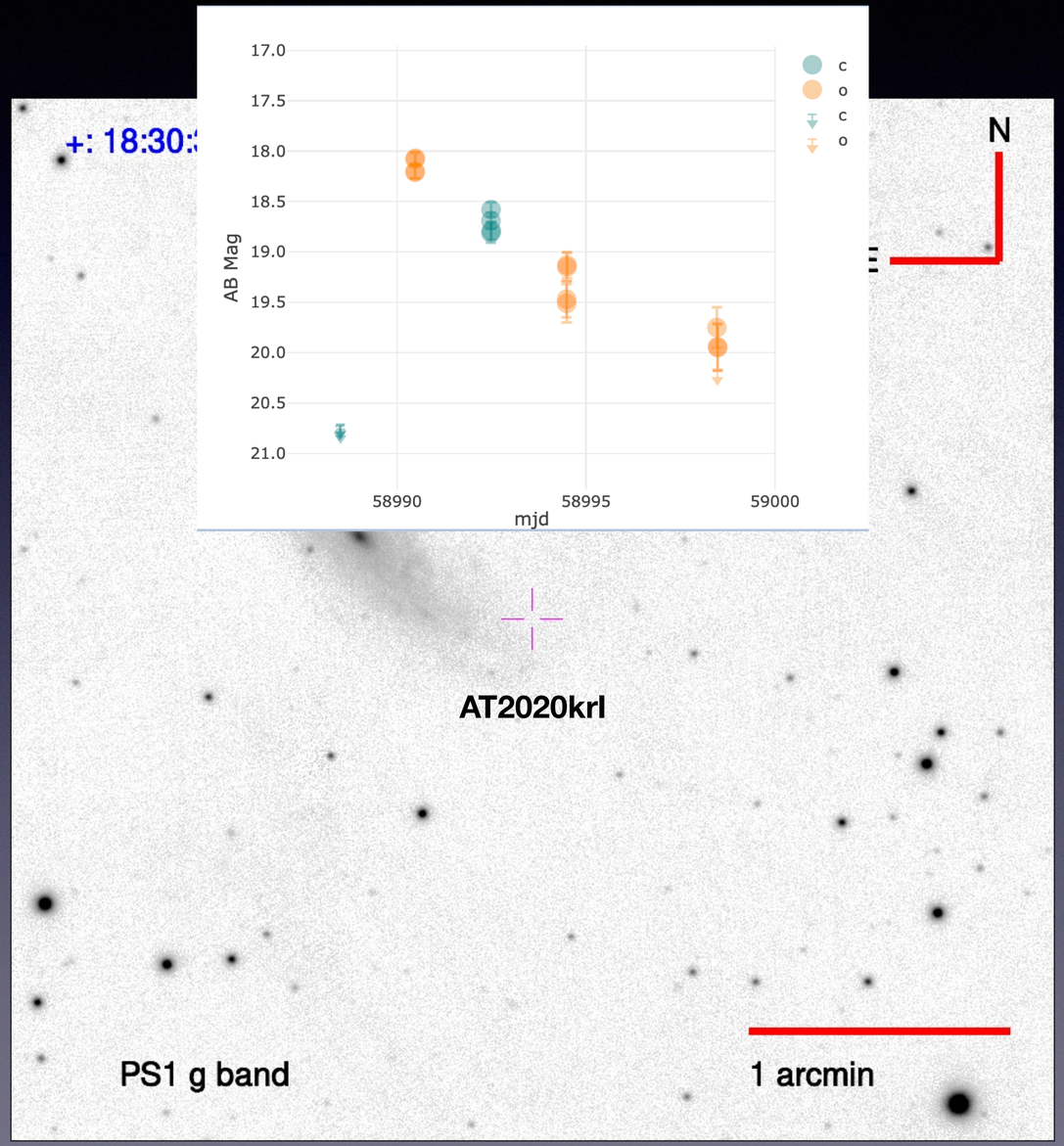

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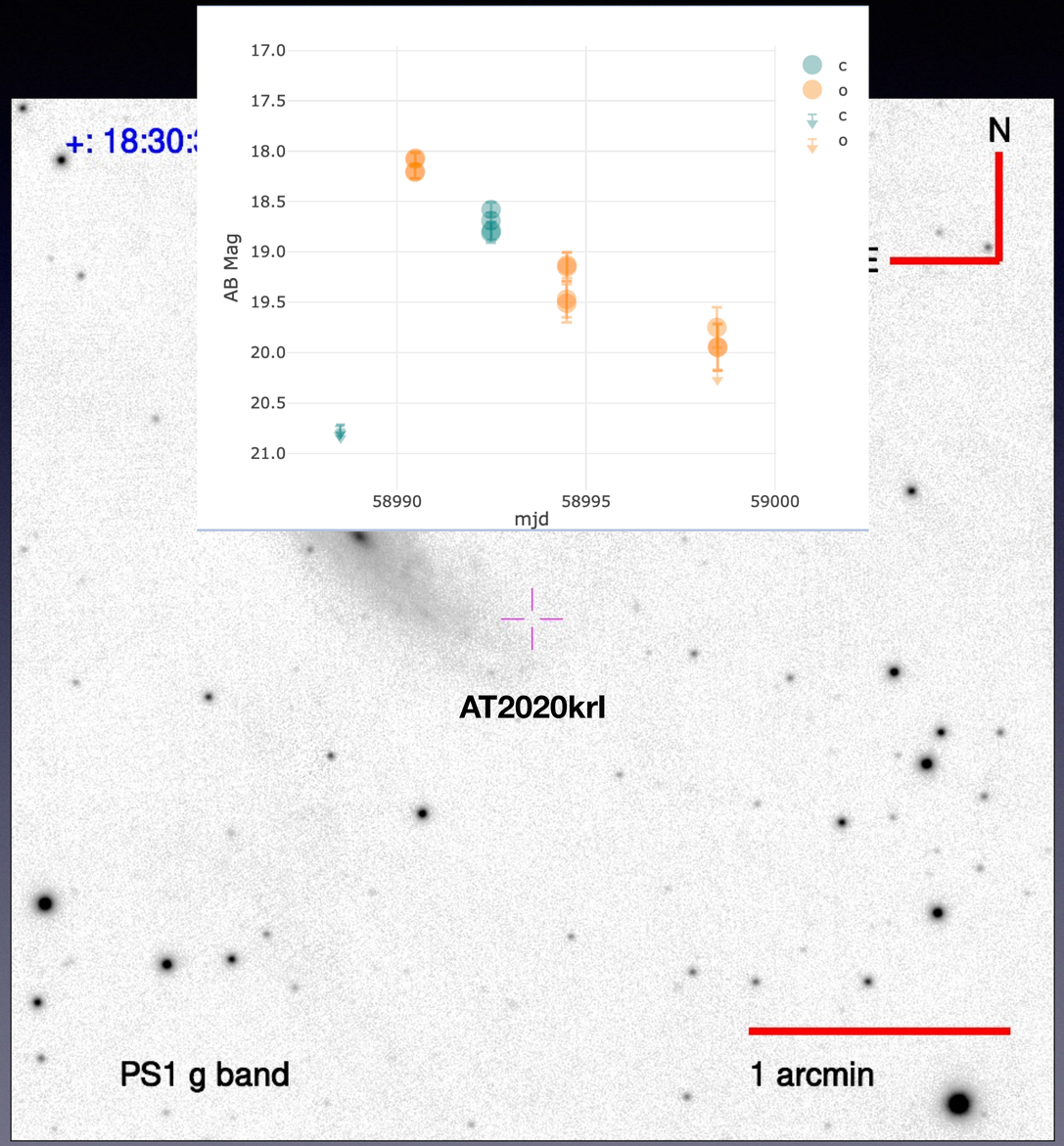

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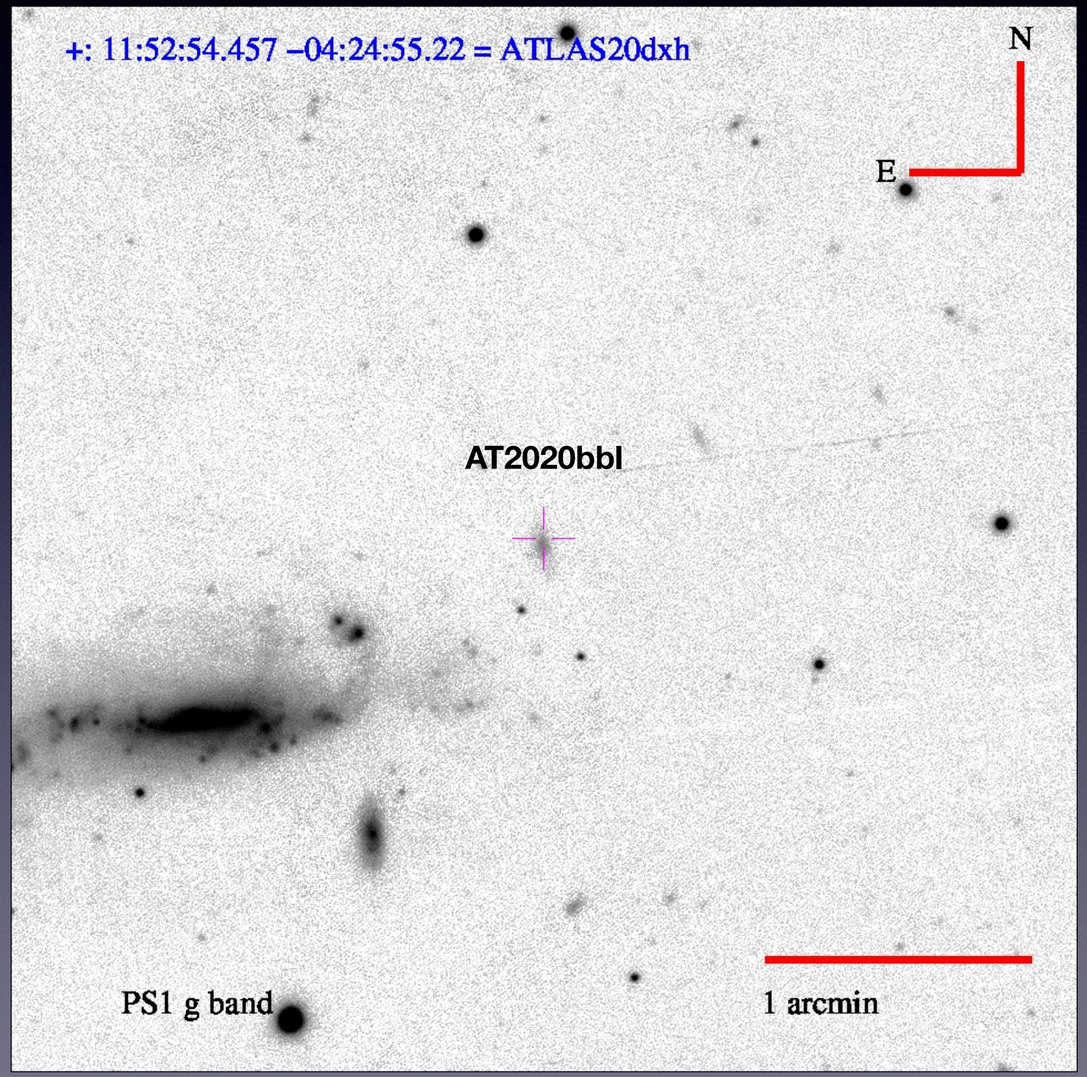

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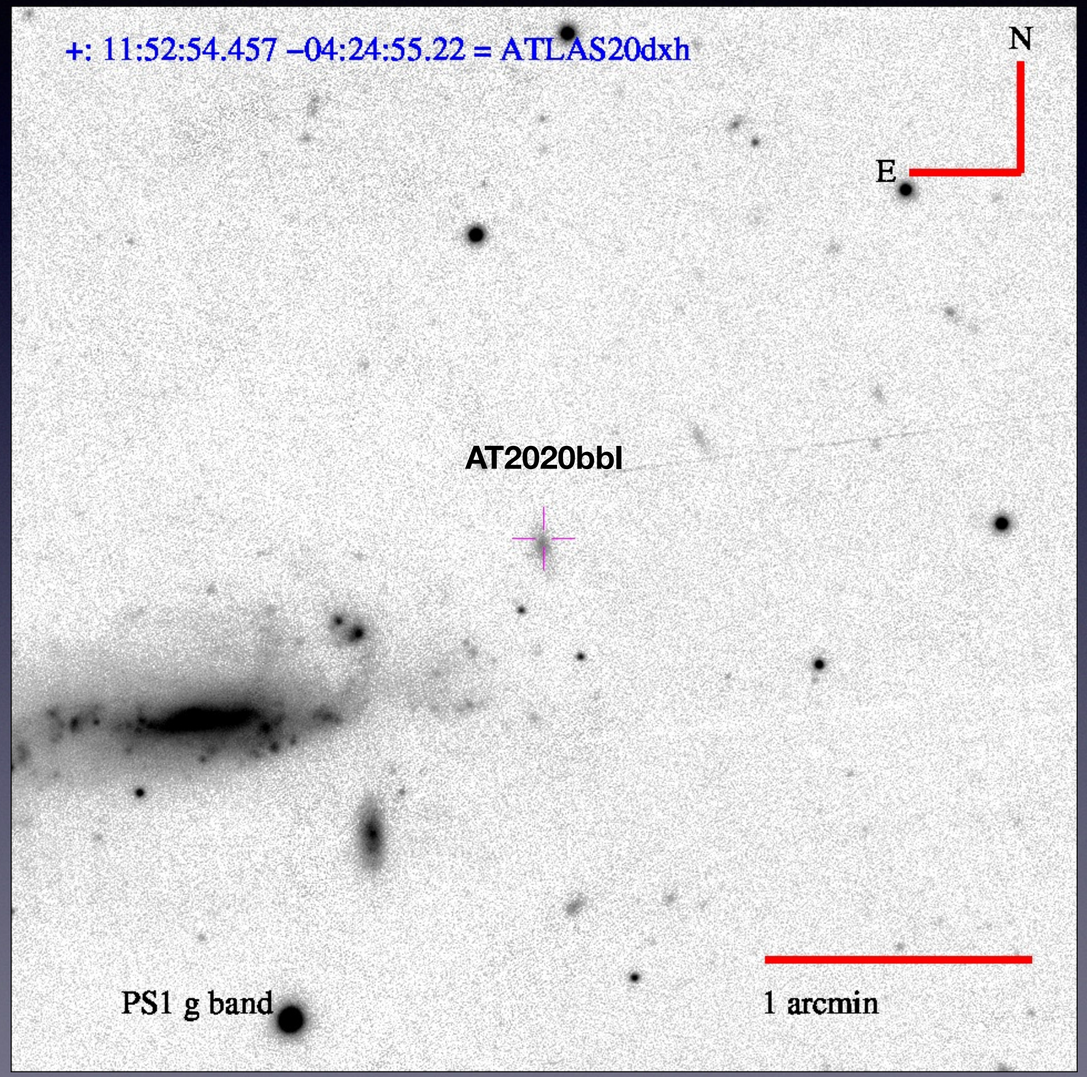

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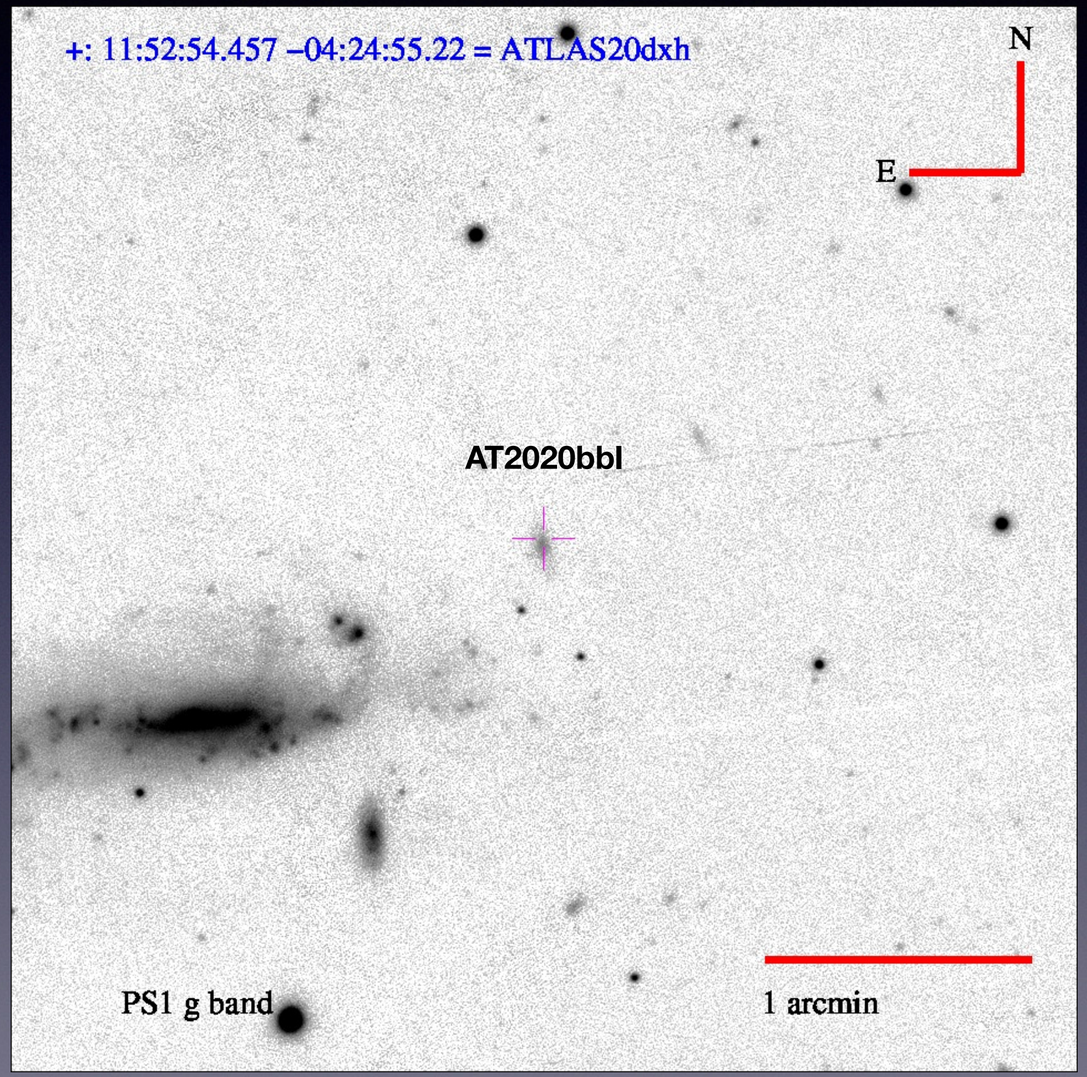
$$\mathrm{RCF} = \frac{N_{\text{known host z}}}{N_{\text{total}}} \approx 0.83$$

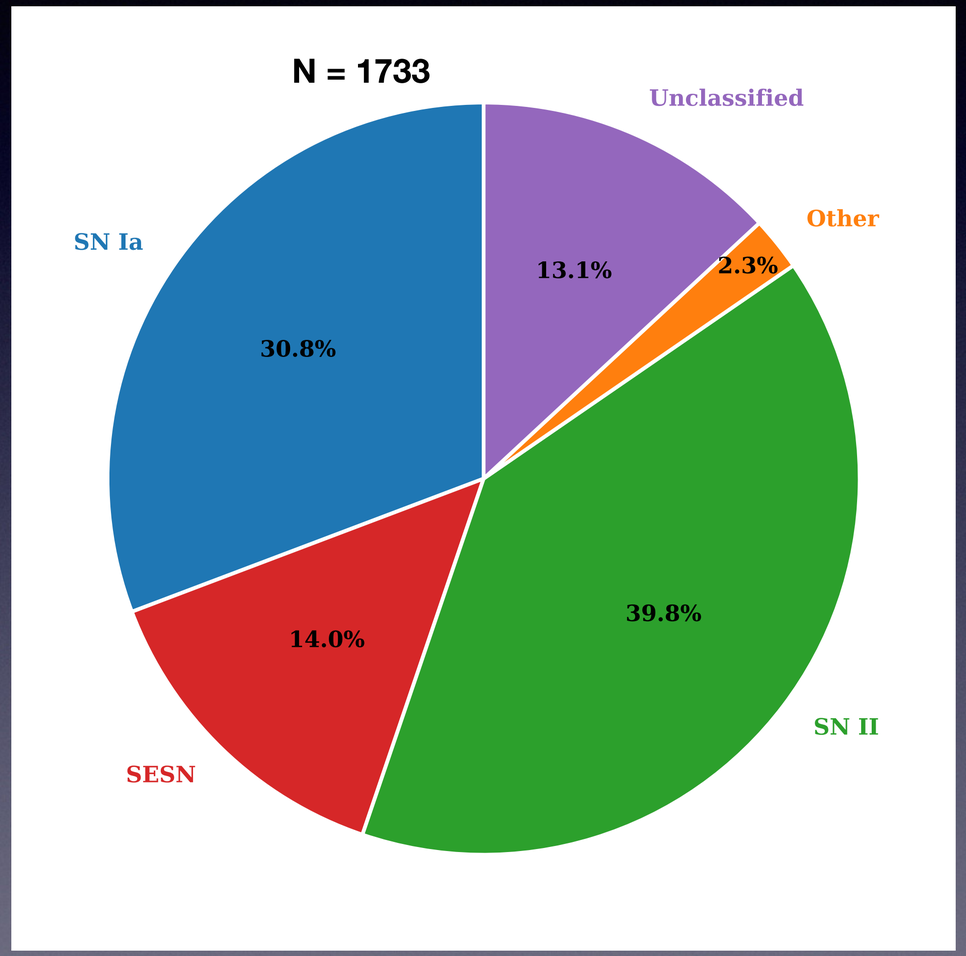
$\mathrm{RCF} \sim 80\,\%$ for $z \lesssim 0.03$

(Kulkarni, Perley & Miller 2018)



Sample demographics

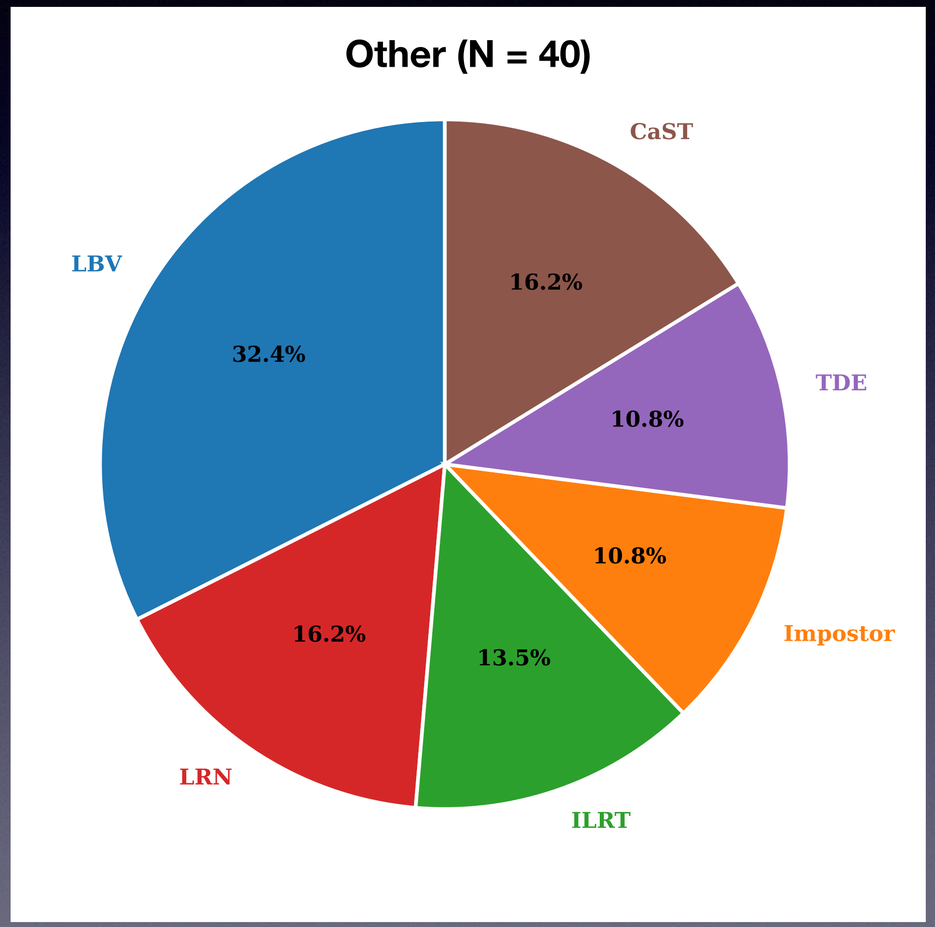
- Classification: ePESSTO+, LT + other collaborators
- AstroNotes for ATLAS discovered 100 Mpc transients
- Public spectra on TNS (classified by ZTF, SCAT, GSP, NUTS etc.)



Srivastav+ in prep

See also ZTF BTS (Fremling+ 2020, Perley+ 2020) and ZTF CLU (eg. De+ 2020)

Projected host separation



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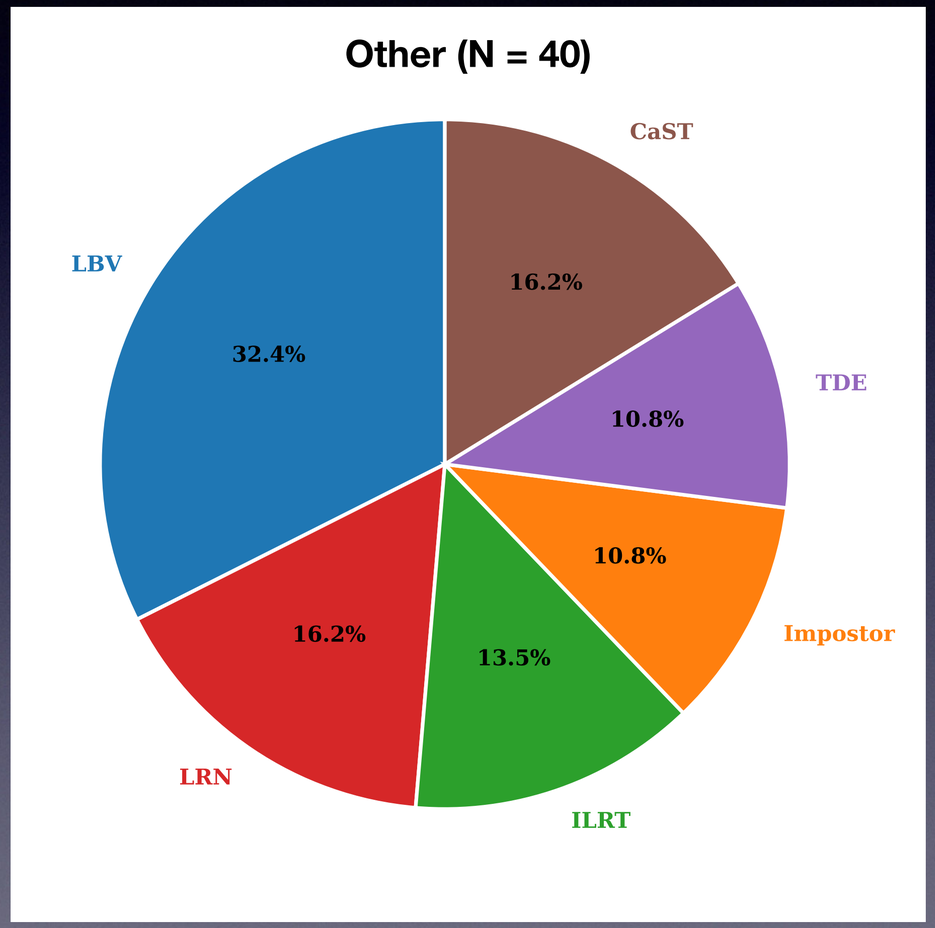
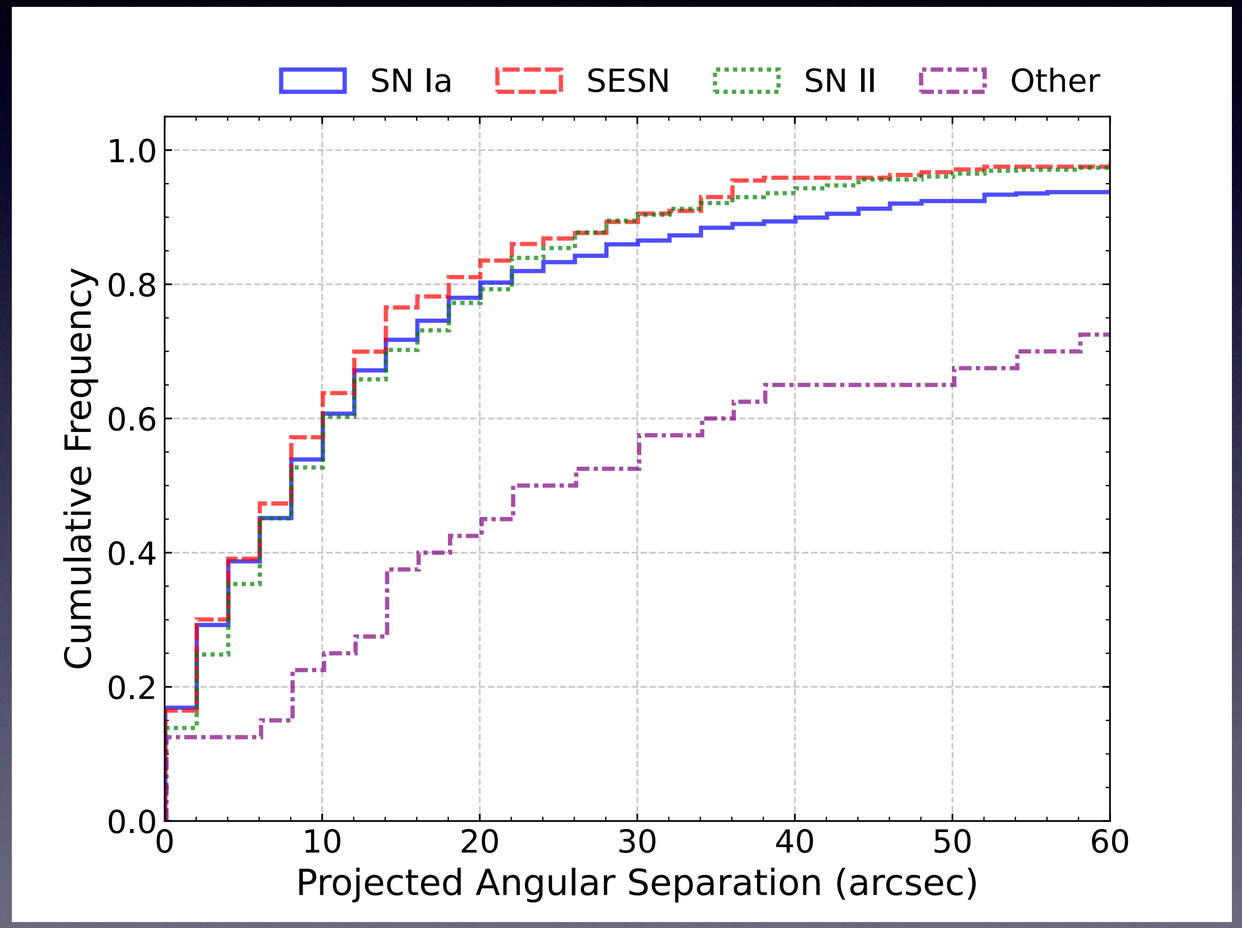
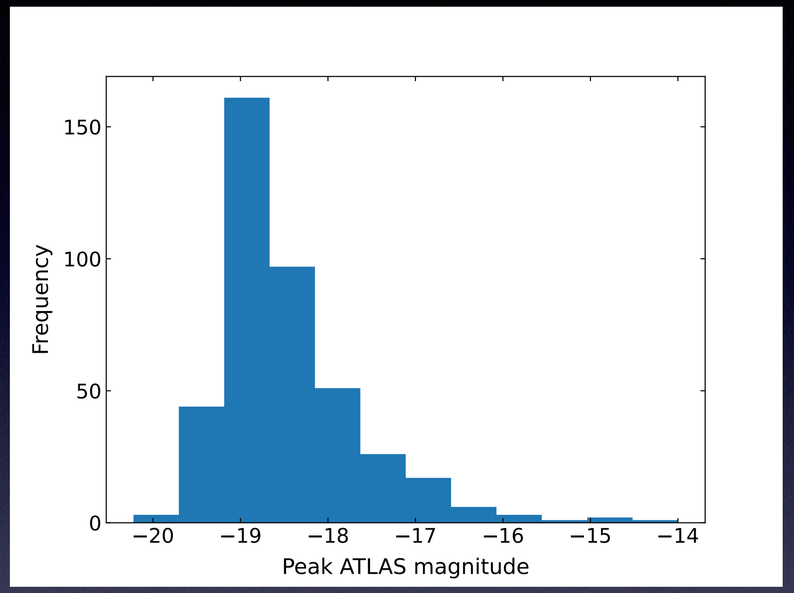




Faint lax supernovae



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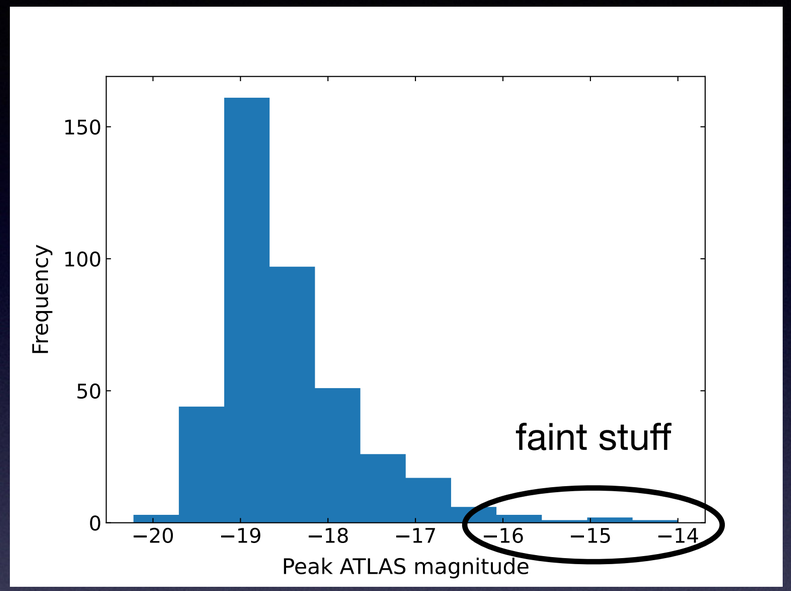

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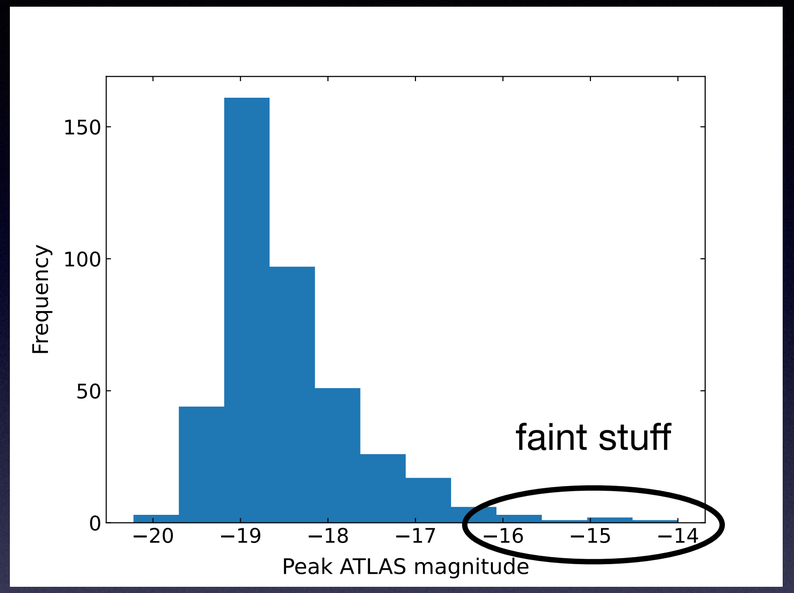

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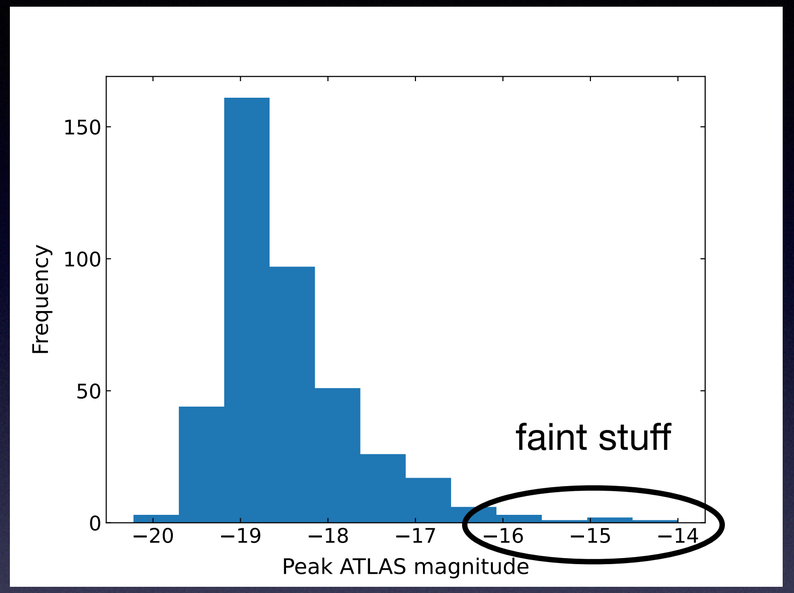

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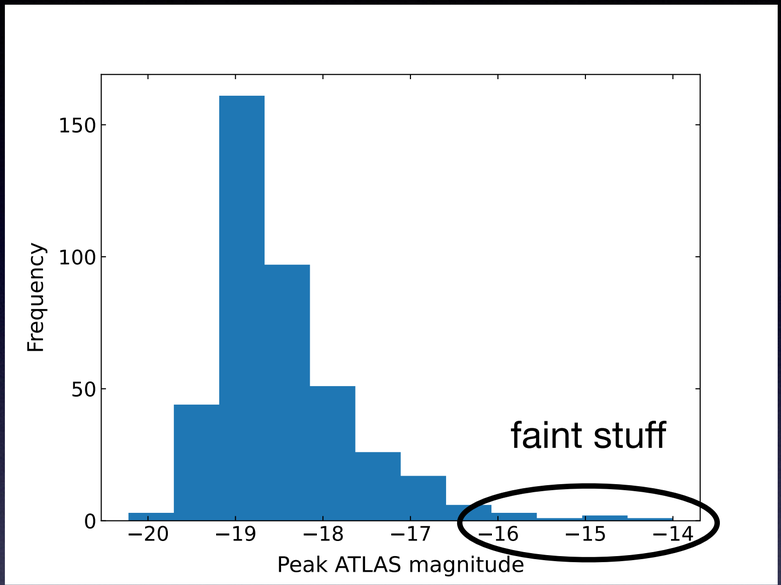

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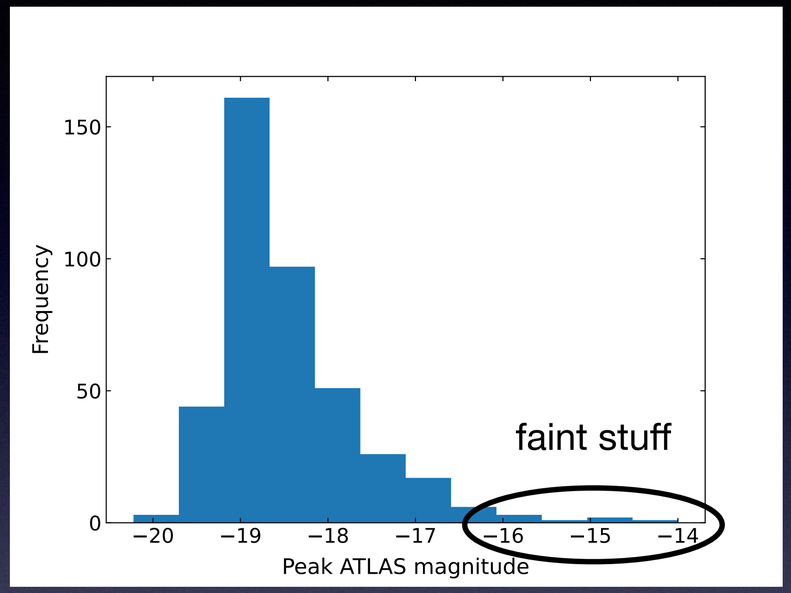

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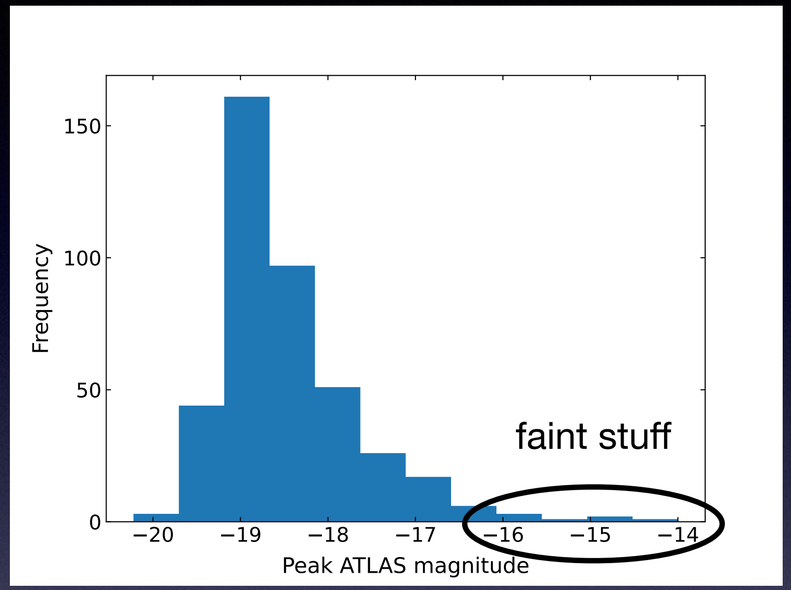

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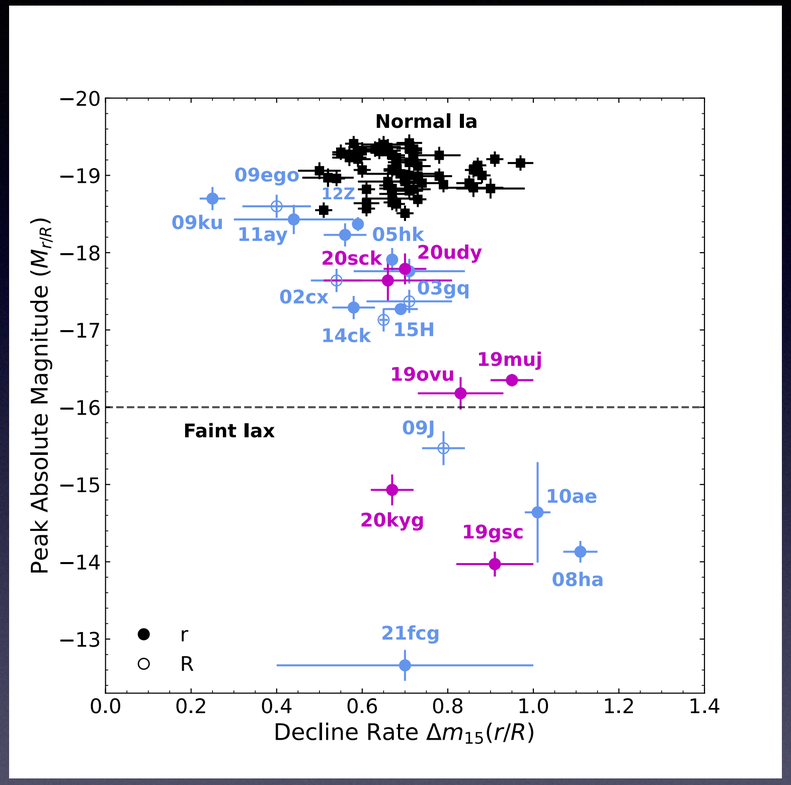

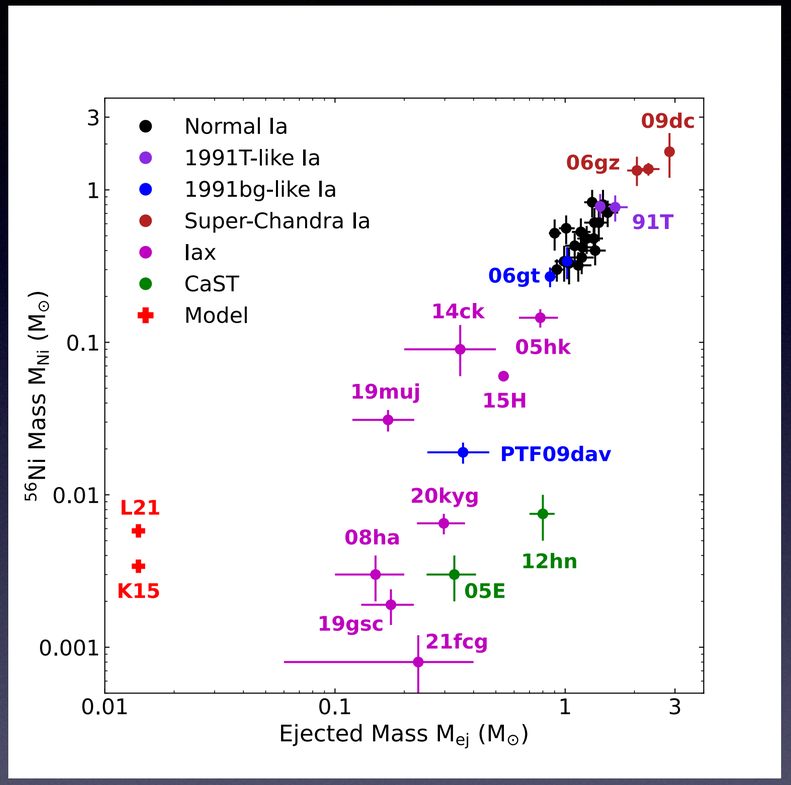

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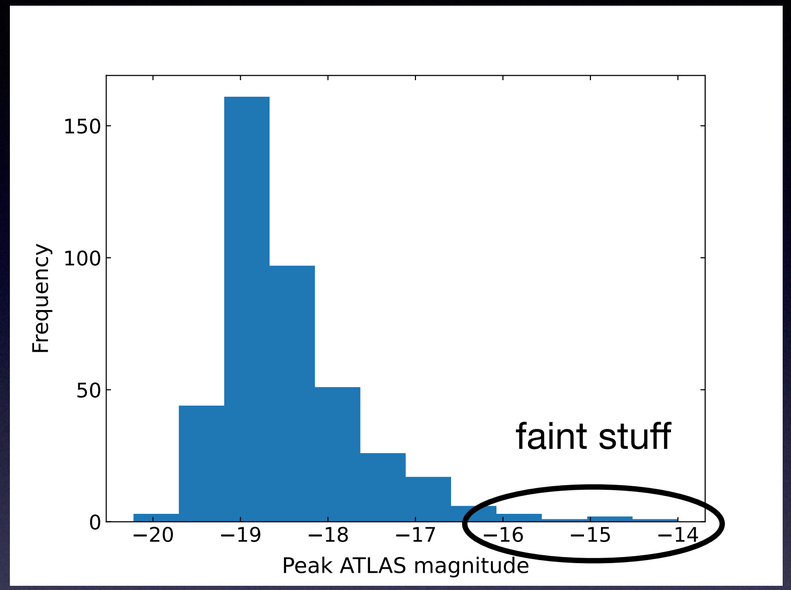

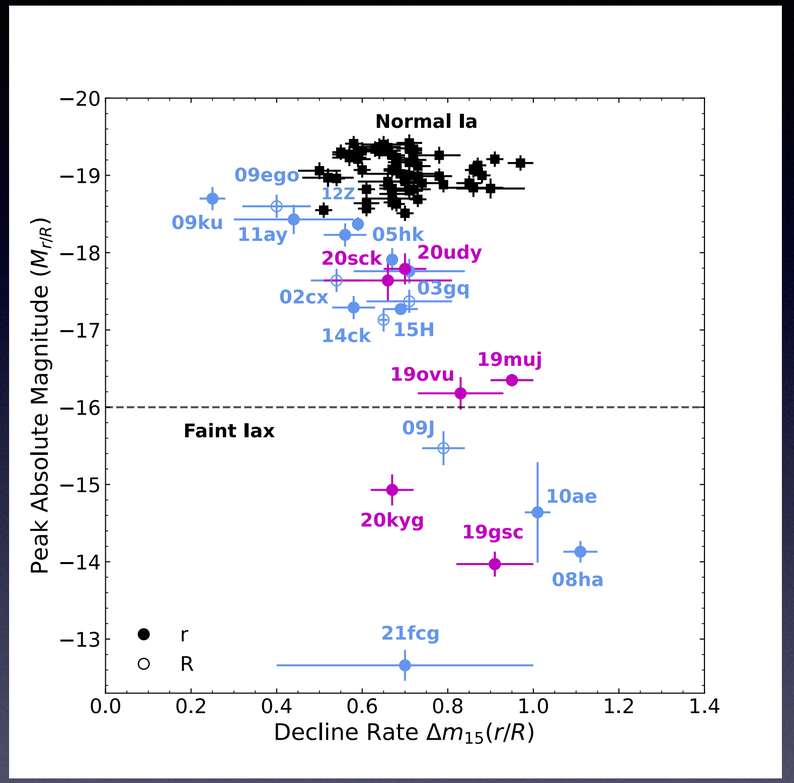

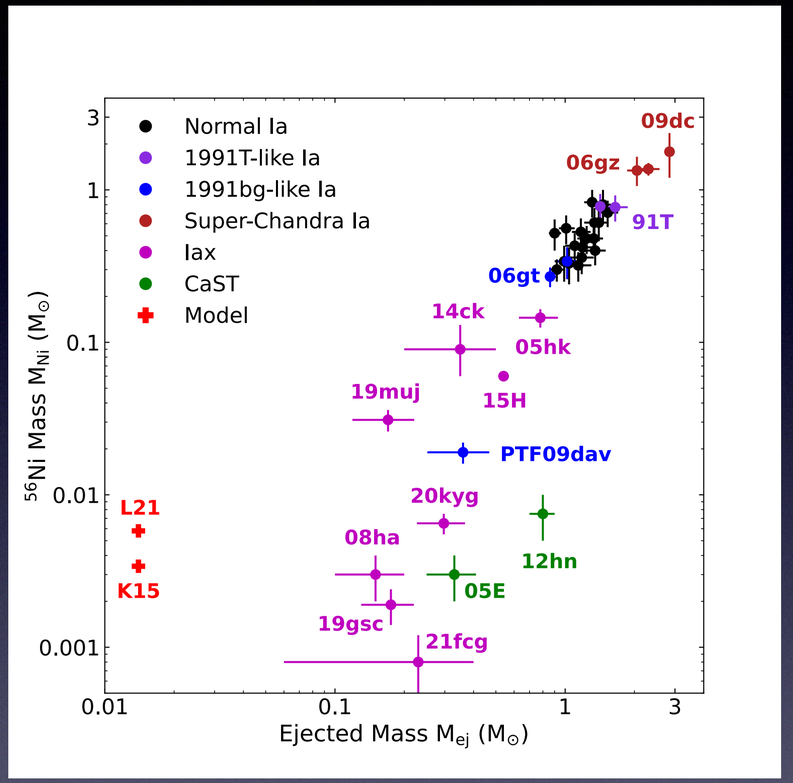

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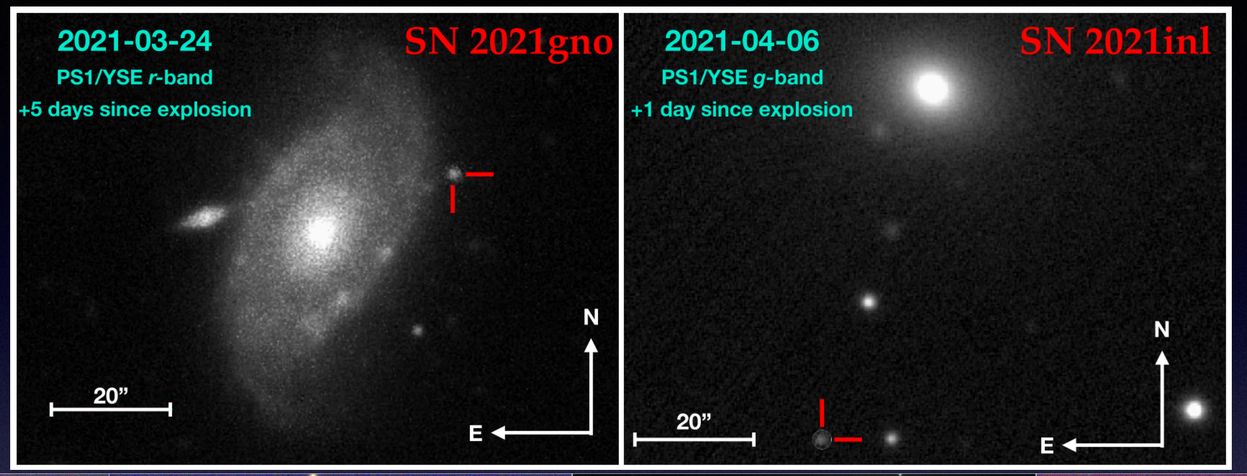
Srivastav+ 2022

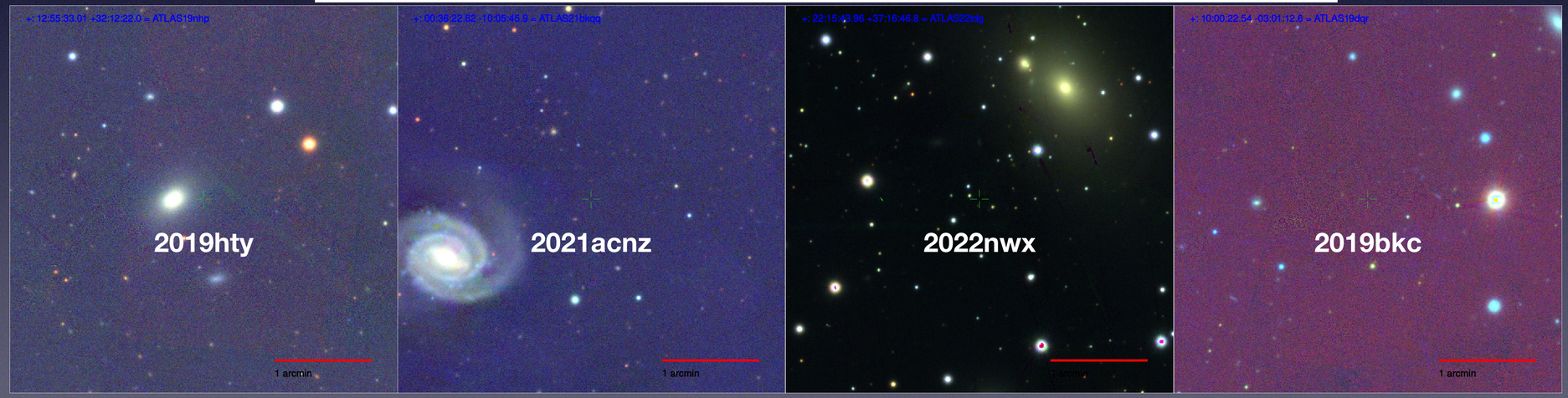
Overall Iax Volumetric Rate: 15^{+17}_{-9} % of the SN Ia Rate

Faint Iax Volumetric Rate: 12^{+14}_{-8} % of the SN Ia Rate

Calcium-strong Transients (CaSTs)

Jacobson-Galan+ 2022





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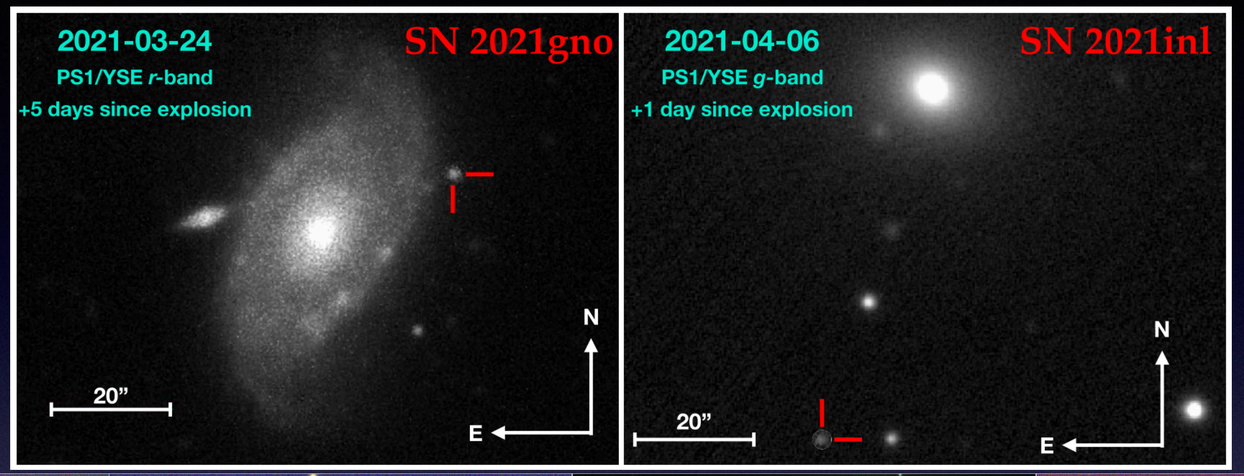

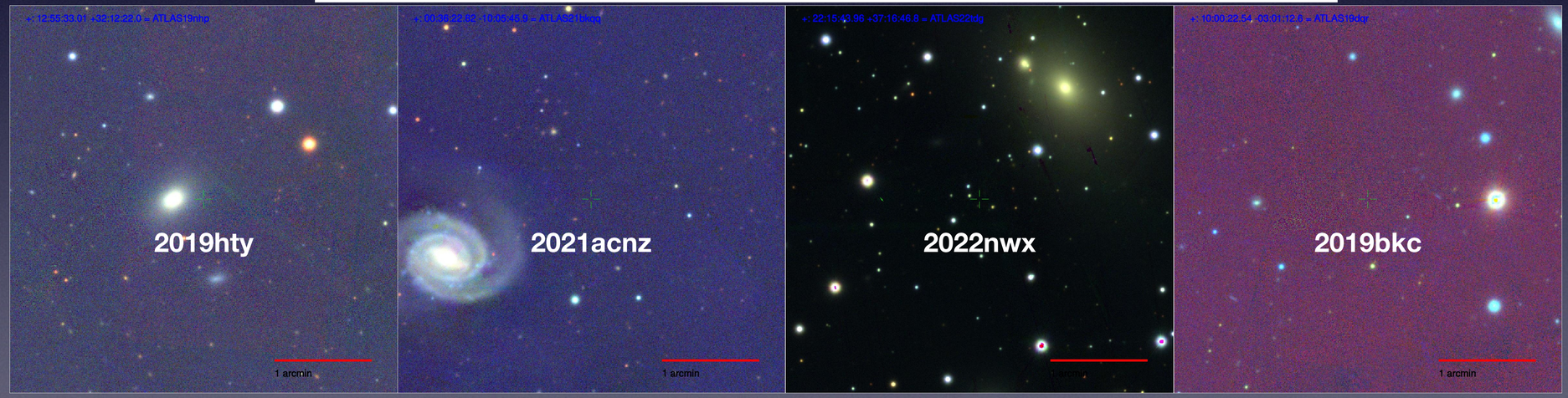

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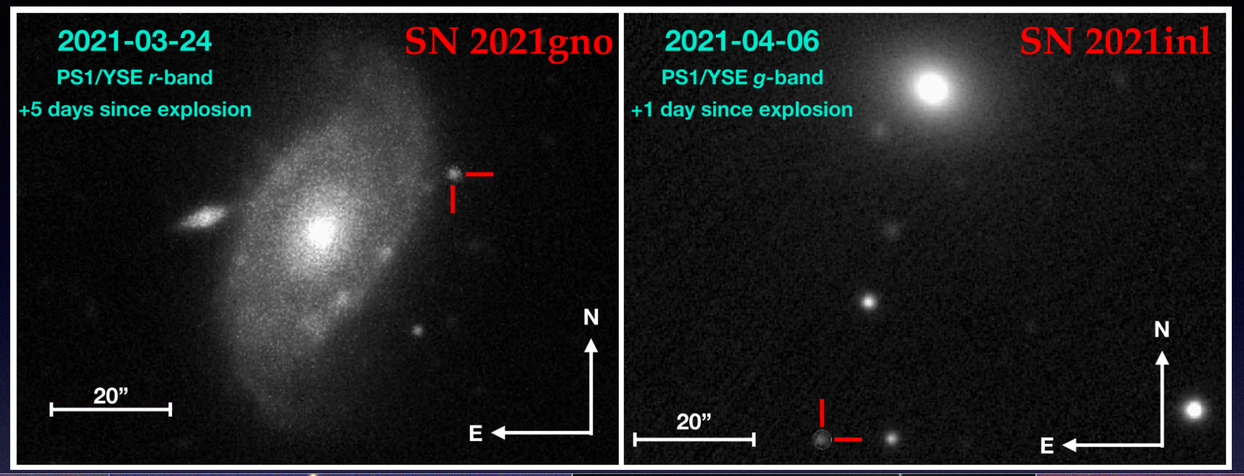
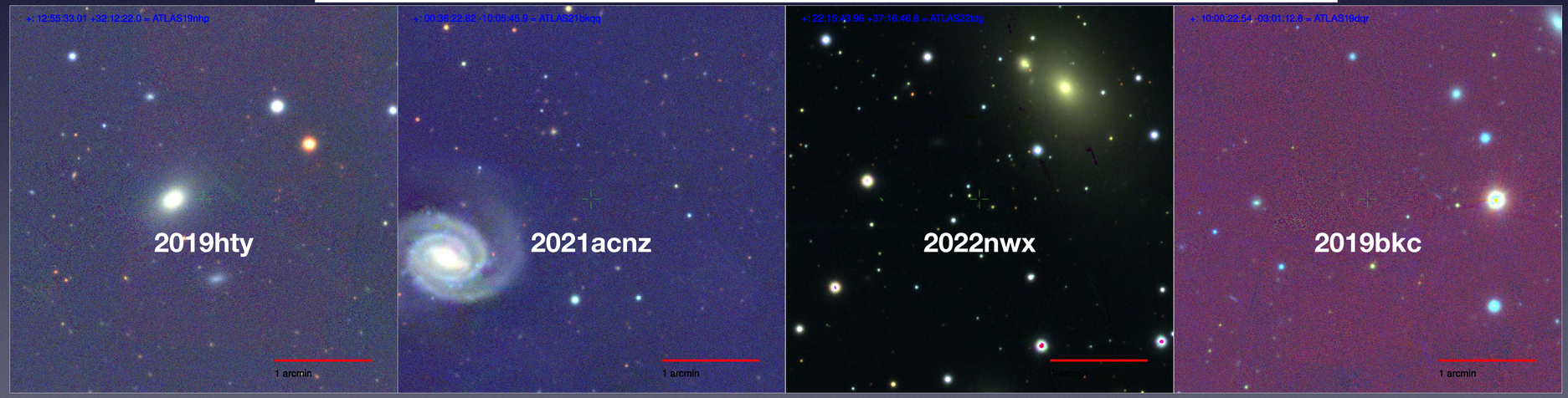
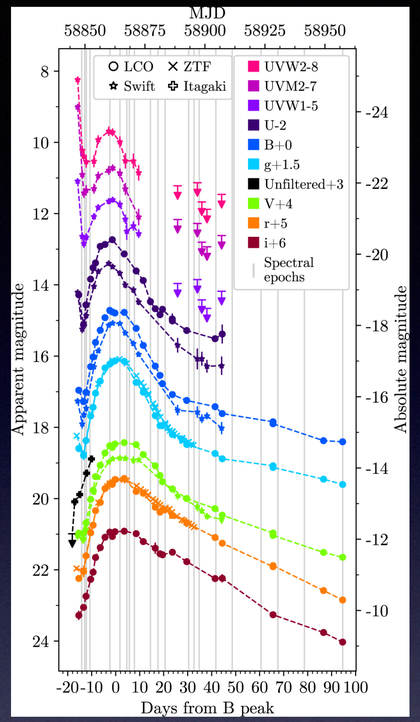


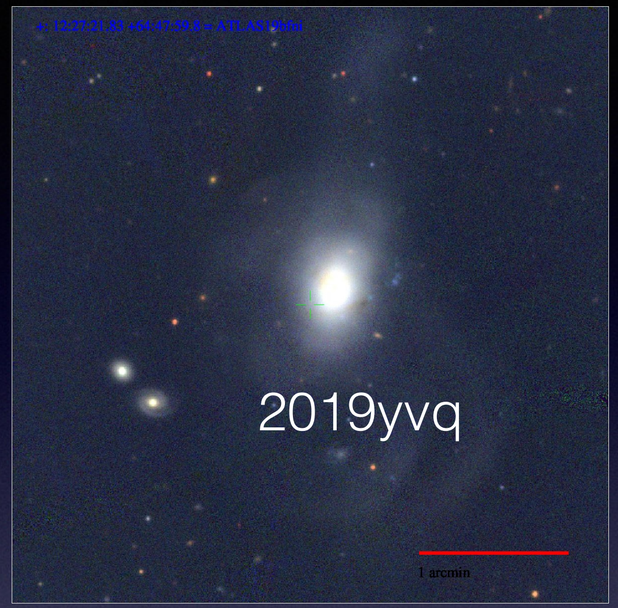


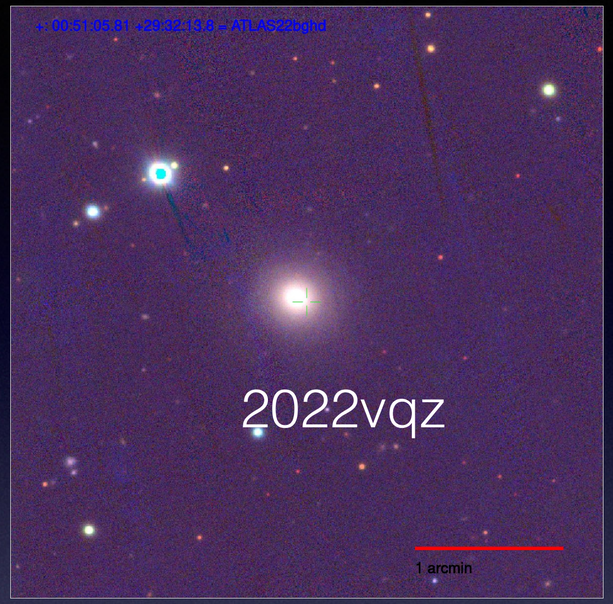
- Double-peaked light curves (50% of the sample): CSM interaction? He shell detonation?
- Low mass CO WD + He WD merger simulations show promise (eg. Moran-Fraile+ 2024, Callan+ 2025)

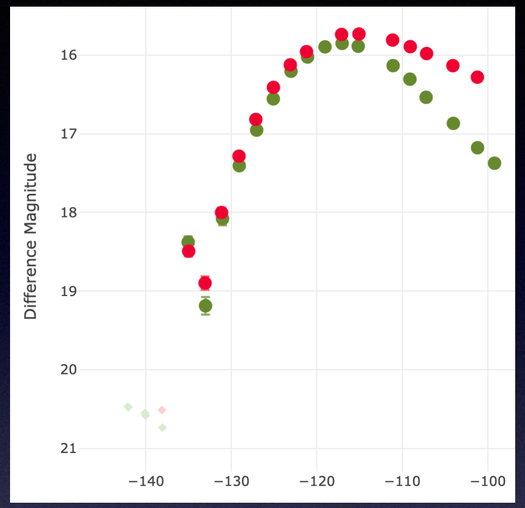
Early excess features in 02es-like SNe Ia



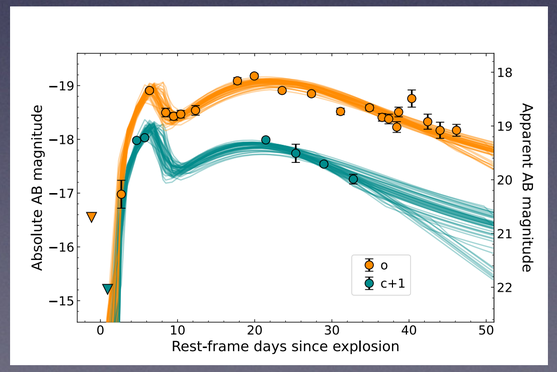
Burke+ 2021



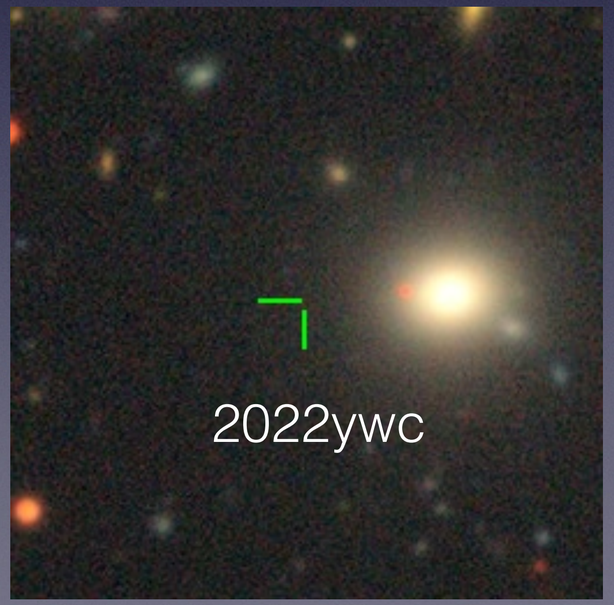


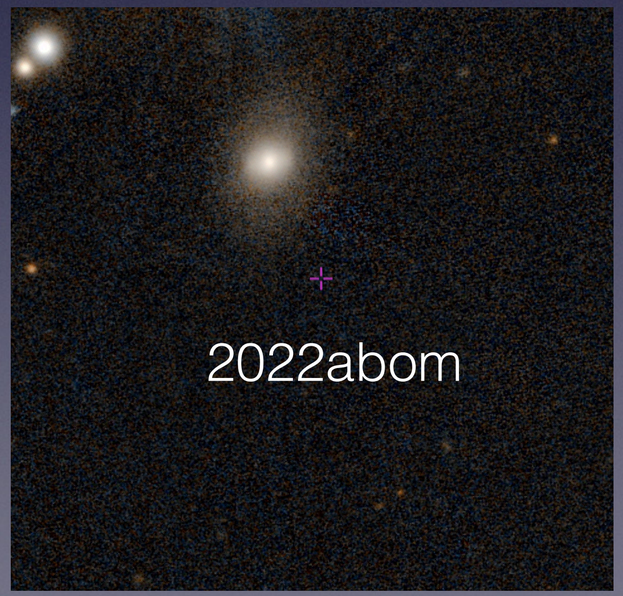


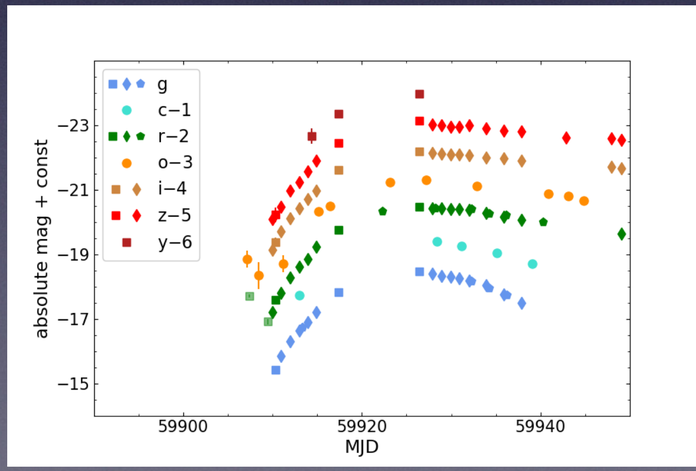
Xi+ 2024



Srivastav+ 2023

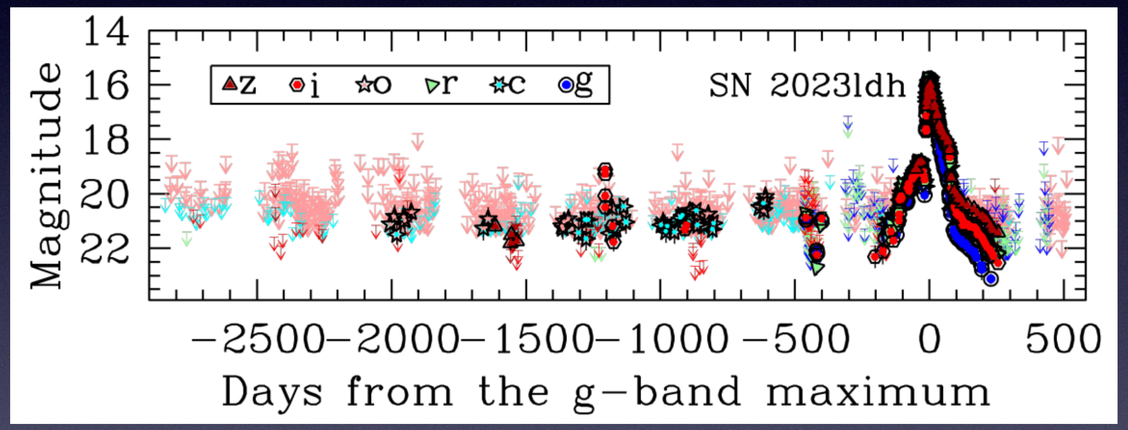




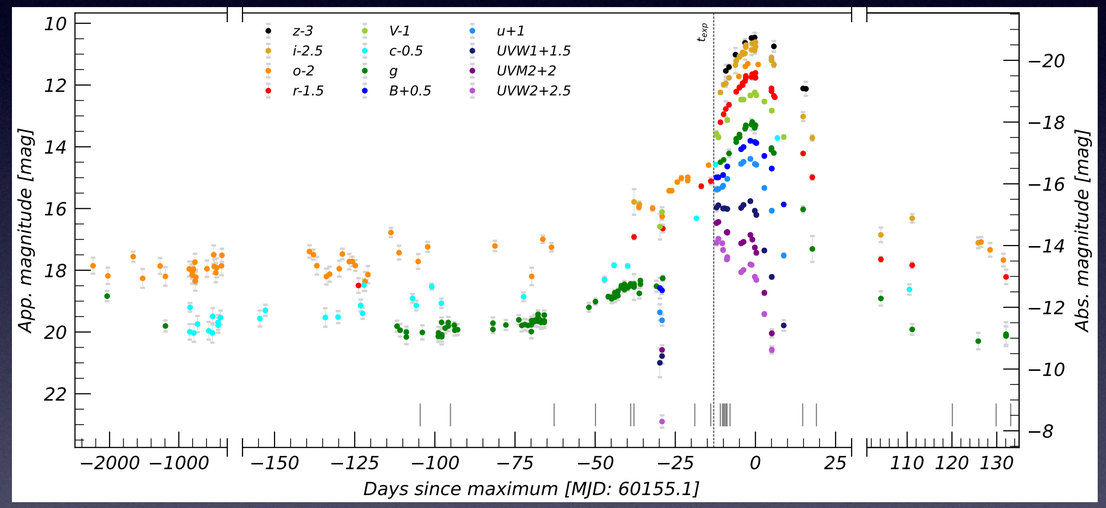


Srivastav+ in prep

Precursors in interacting SNe

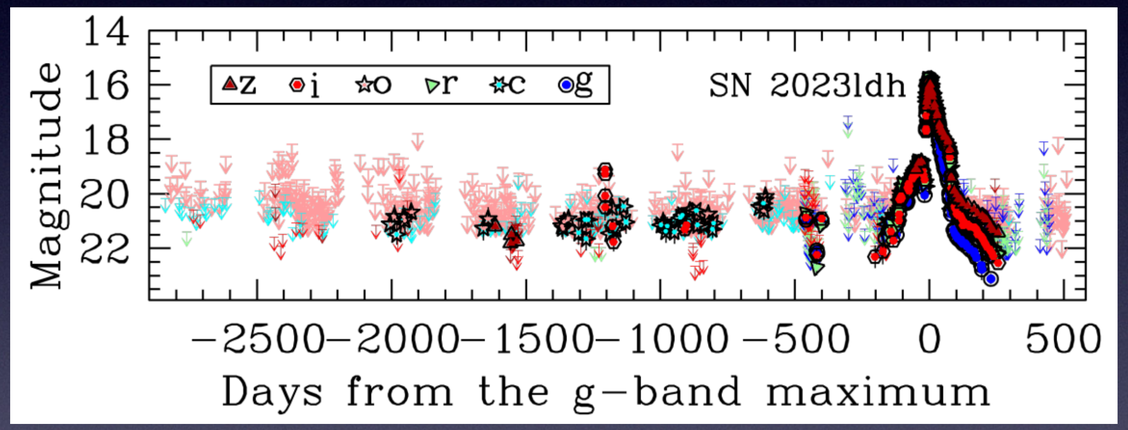


SN 2023ldh (IIn)
Pastorello (+Srivastav) et al. 2025, submitted



SN 2023fyq (Ibn)
Brennan+ 2024

Precursors in interacting SNe



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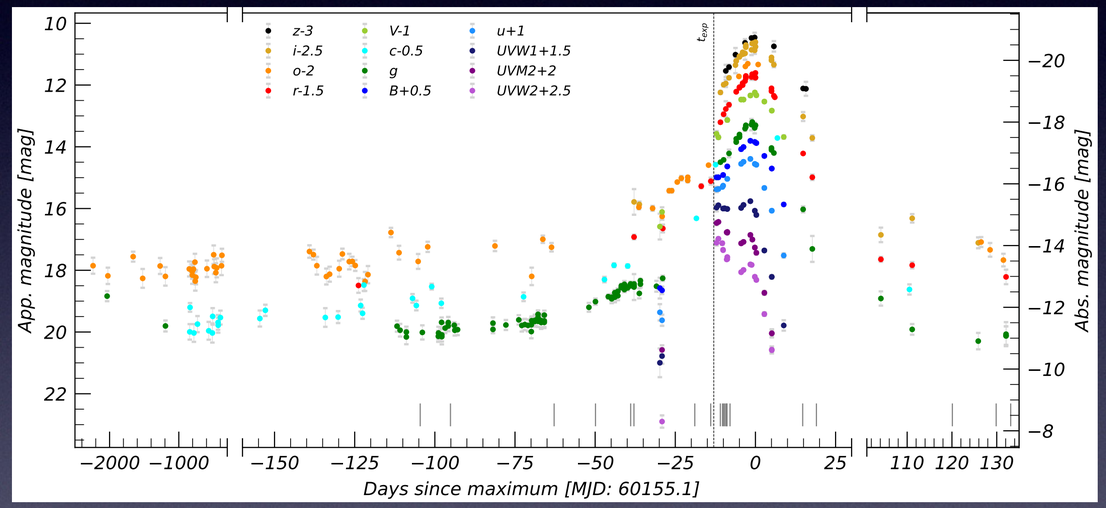
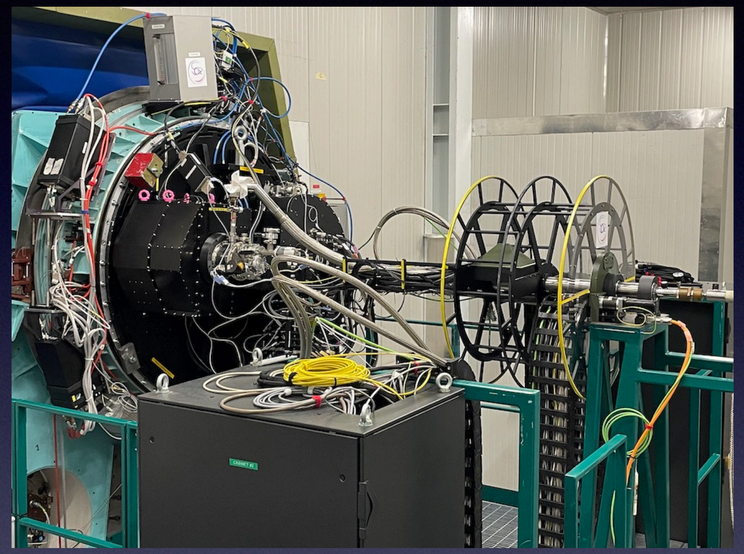


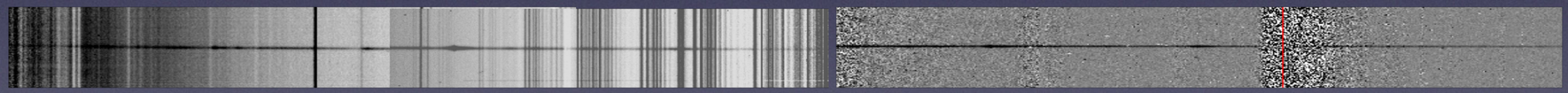
SN 2023fyq (Ibn)
Brennan+ 2024

7/44 ($\gtrsim 15\%$) SNe IIn in the ATLAS 100 Mpc sample have evidence of precursor outbursts in ATLAS + PS history

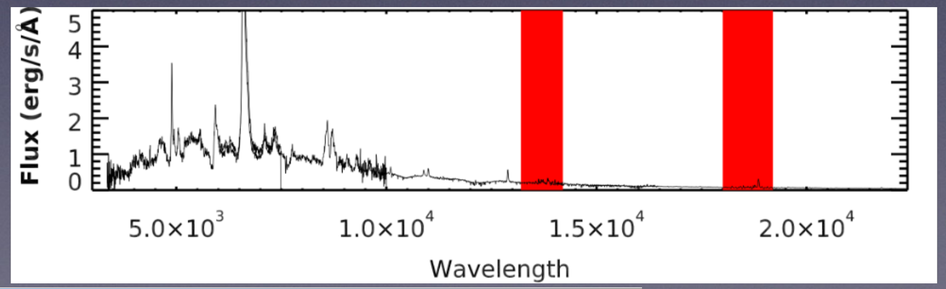
SOXS : ESO's transient follow-up machine
SOXS GTO Consortium 50% of time



SOXS now installed on NTT
0.35 - 2.0 μm in one shot
R ~ 4000
High throughput, factor >2 better than EFOSC2
Imaging camera (3 arcmin, *ugrizy* filters)
Will be permanently mounted from 2026 for science, telescope in queue mode, ToOs at any time



UV-VIS
0.35-0.8 μm



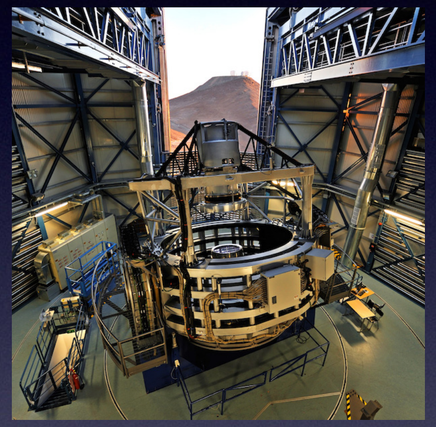
NIR
0.8-2.0 μm

SOXS

PI: Sergio Campana (INAF, Brera)
PM: Pietro Schipani (INAF, Napoli)

Spectroscopic follow-up of Rubin targets

large numbers



4MOST
2500
spectra in one shot.
Fibre spectrometer

fast

New Technology Telescope,
refurbished with
new spectrometer.
0.3 - 2.μm.
50% of time
guaranteed.

fast

Very Large Telescope

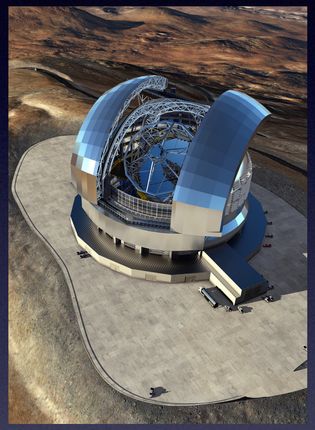
Large programme awarded.

sensitive

JWST

NIRSPEC
MIRI
0.5 - 20 μm

sensitive



Extremely Large Telescope
2029+
HARMONI

Forging a new synthesis between theory and observation

Queen's University Belfast

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