

Roman high-redshift transient Science (RISE): Enabling a Non-Cosmology Time-Domain Program

--- a Wide-Field-Science (WFS) program funded by NASA in 2025

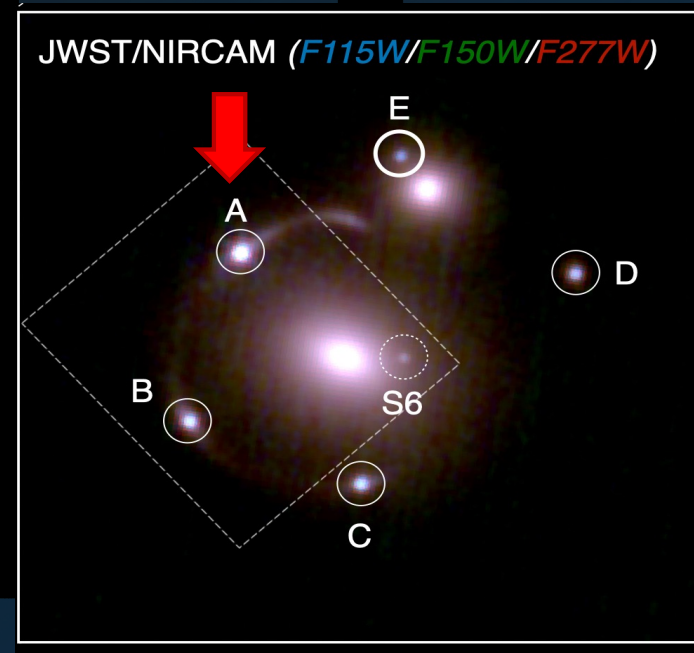
Principal Investigators: Lin Yan (Caltech) & Ori Fox (STScI)

Co-Investigators: M. Kasliwal, S. Van Dyk, B. Rusholme, J. Jencson, A. Mahabal (Caltech), A. Rest, D. Coulter, J. Pierel (STScI), R. Quimby (SDSU), Y. Yao (Berkeley), R. Stein (UMD) L. Strolger, M. Shahbandeh, M. Siebert (STScI), T. Moriya (NAOJ), Ryan Lau, R. Laher, J. Santana (Caltech)

New frontier -- High-z transients -- One example: SN2025wny – a strongly lensed SLSN-I at $z=2.011$

Superluminous supernova:

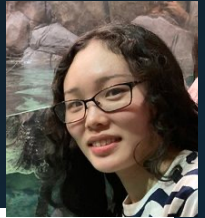
- 10-100 more luminous
- Likely detected by Roman at high-z
- High impact science:
 - Explosion physics not understood
 - Related to exotic explosion, e-e⁺ pair instability



SN2025wny: Accepted JWST DDT with observations into 2027

Maggie Li

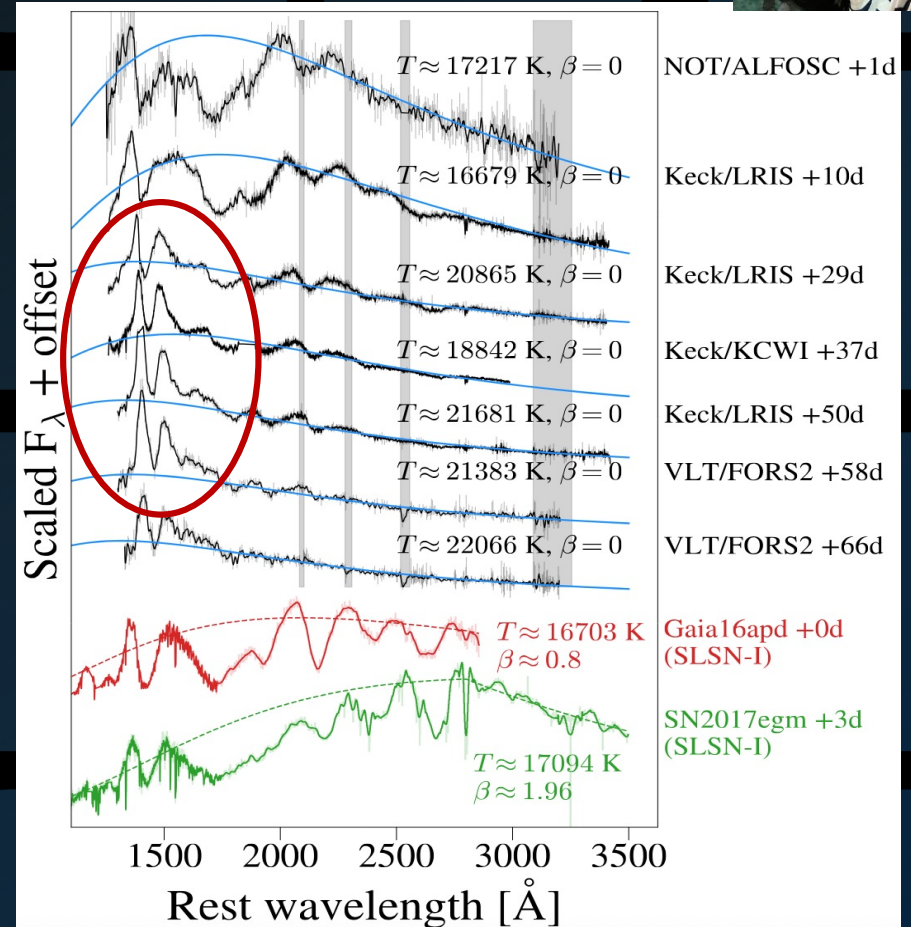
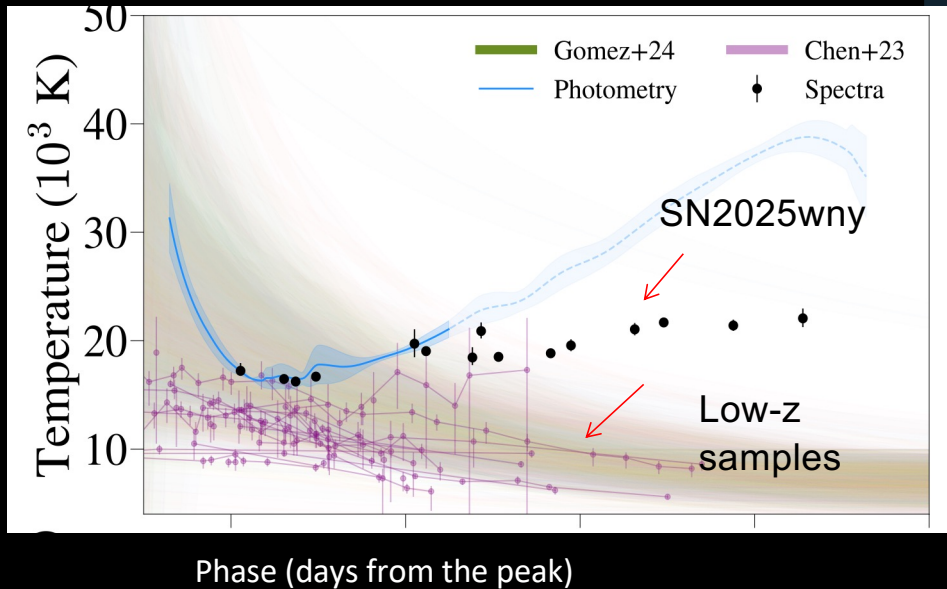
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SN2025wny at $z=2$: very **UNUSUAL**:

- unusual CII, H α , HeI at 1.08 μ m
- far-UV **too bright** – strong UV continuum + unusual FUV spectral features
- Temperature **too HIGH** (models do not work)

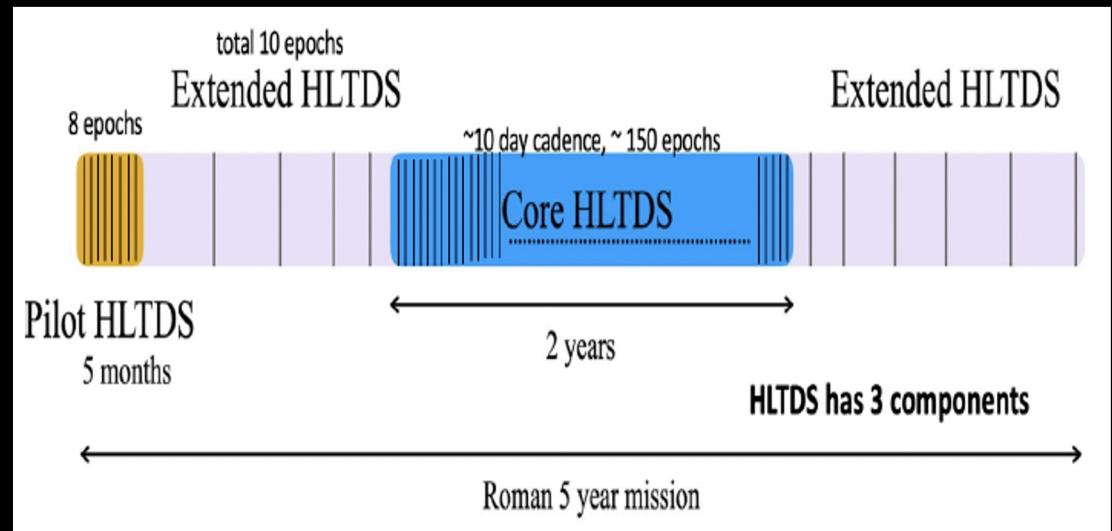
Li, M., Yan, Lin et al. 2026 to be submitted



RISE objectives:

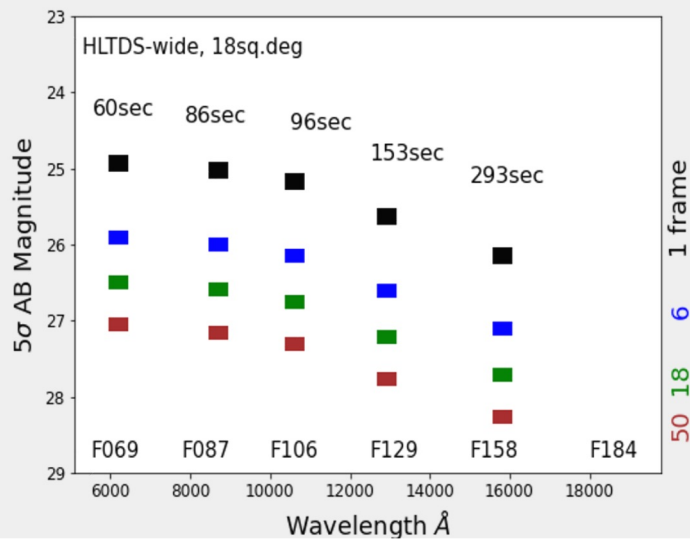
- Dynamic & automated stacking with multiple cadence
- A pipeline for faint transients from image coadd and subtraction
- Multi-alert streams to the public
- To build post-alert characterization and prioritization machinery to identify high-z transients.

Roman Fields suitable for
RISE coadd: any fields with
multiple images



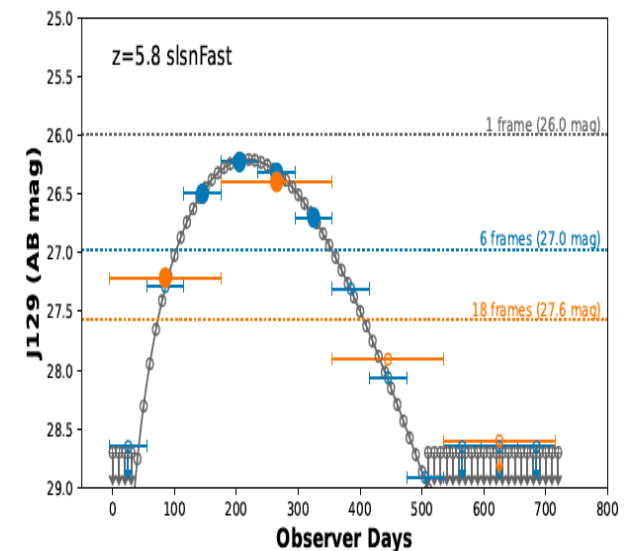
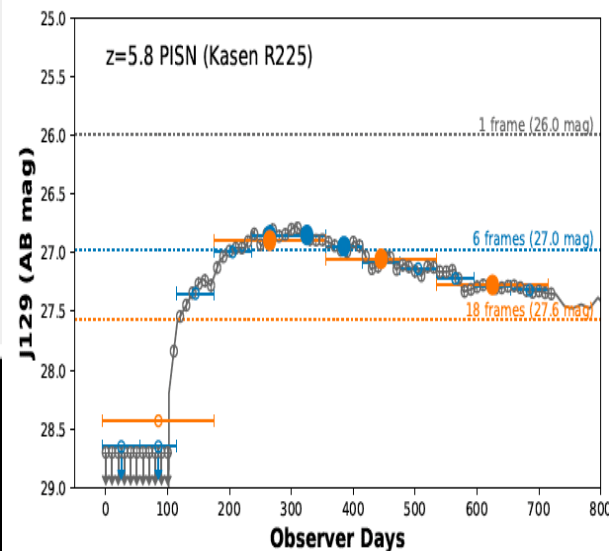
How deep can RISE stacking reach?

A case in high-latitude time domain survey (HLTDS) -- 1-2 mag deeper than single frame

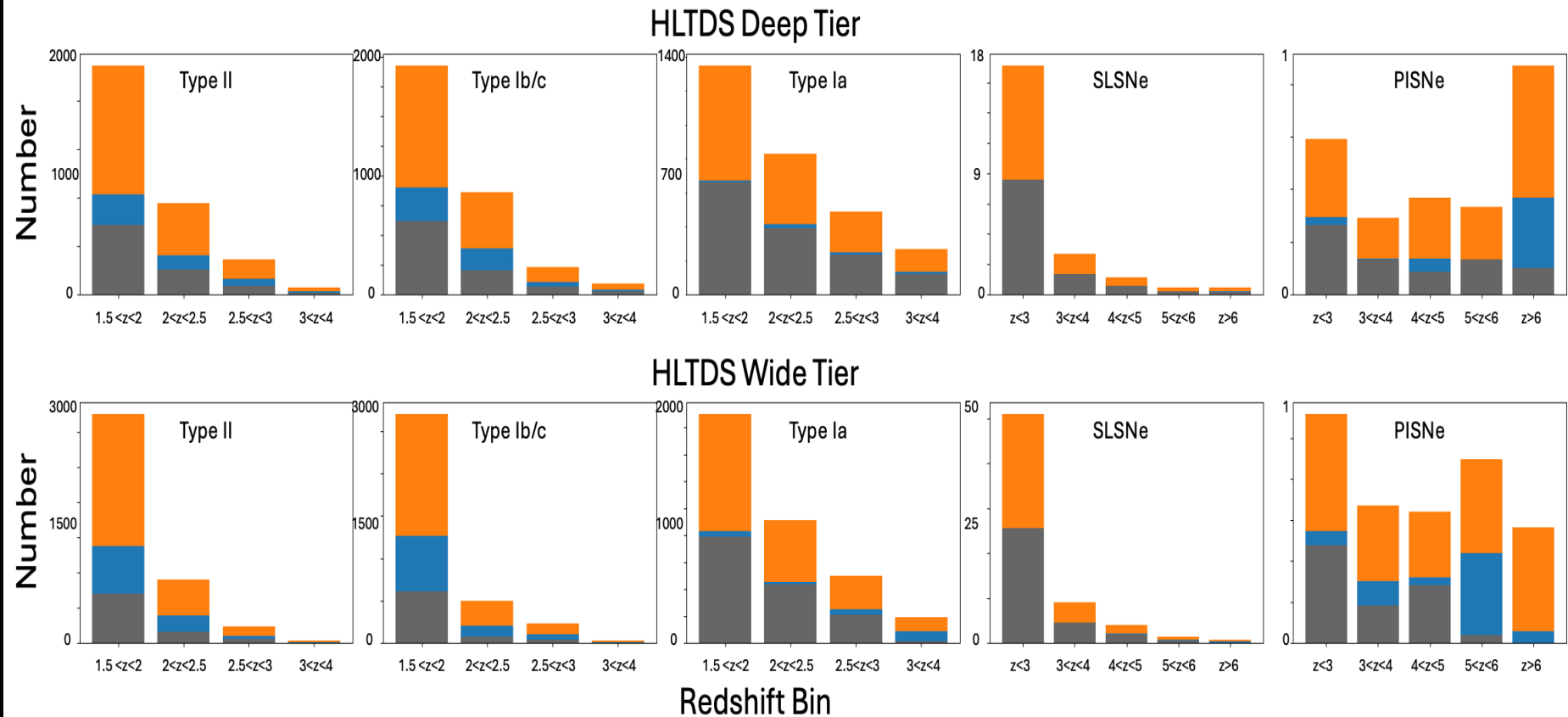


HLTDS-deep is 1 mag deeper. 28 & 29 mag are at COSMOS & JADES JWST depth

Predicted SLSN and PISN LCs seen by Roman



Estimated large numbers of $z > 1 - 6$ ccSN, SLSNe & PISN in HLTDS:

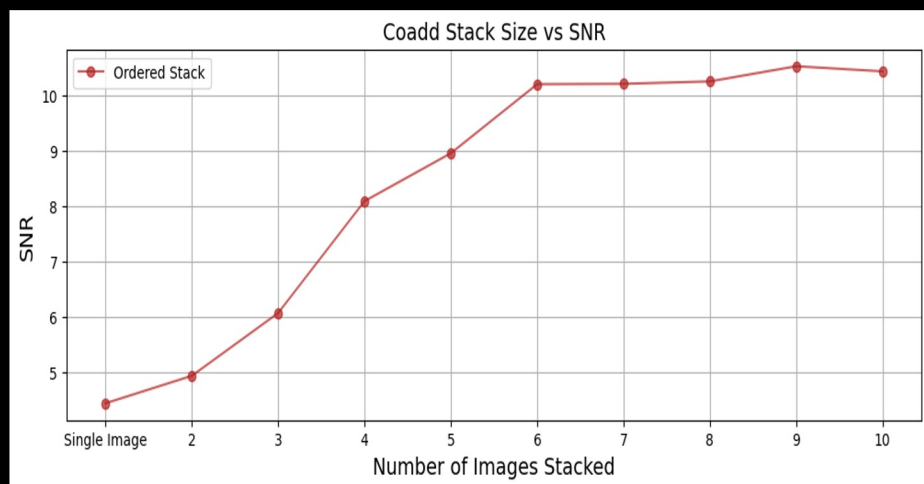


Status of the RISE pipeline development:



Joseph Santana,
post-back @caltech

1. Image stacking: Using AWAICgen software
2. Stacked image subtraction:



Status - continue:

3. PSF in stacked images:

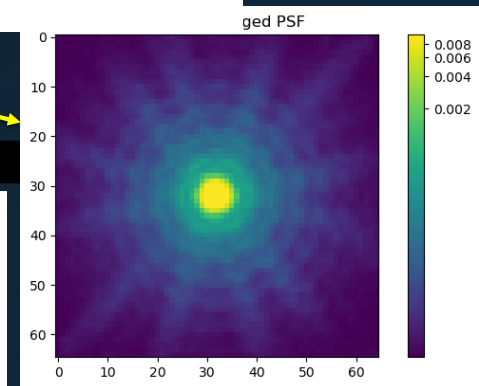
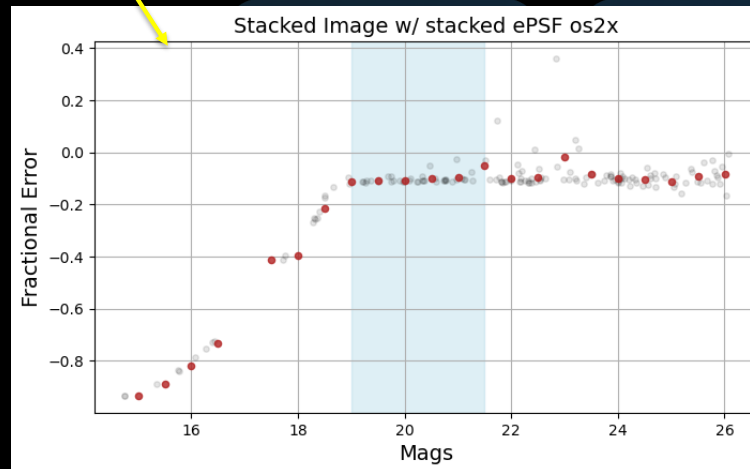
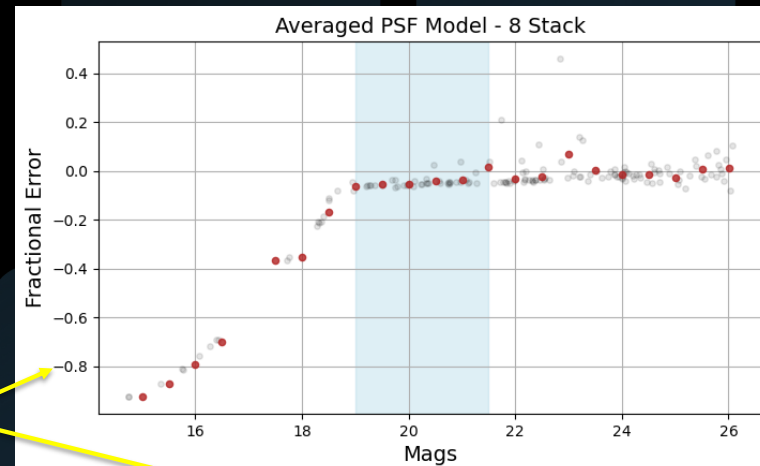
Two methods:

- (1) compute the averaged-PSF w/ different PA & SCA based on the Roman PSF derived from IOC data.
- (2) measure ePSF from the coadded images

4. More tests to come:

- PSF photometry on the subtracted images
- End-to-end tests

5. Alert streams (to-do item)



Post-Alert Characterization: Machine Learning Classifier

- Combine Inputs
 - Forced-photometry light-curves
 - Host-galaxy photo-z
 - Color-Magnitude phase-space
 - Light curve fits
- Training Data Set
 - JWST high-z transient sample as a training/truth set
 - Low-z data from ZTF
- Possible solutions
 - Explainable boosting machines
 - Variational autoencoders
 - Explore multi-modal data + foundation model (akin to SkAI's SELDON for Rubin)

Accepted Roman Cycle 1 program:
Implementing a High-Redshift Supernova
Program with Roman's WFS RISE Sample
PI: O. Fox
Co-Is: RISE and RAPID team members &
more



Conclusions

- High- z supernovae represent the next frontier of time-domain astronomy
- Roman will probe near-IR dynamic sky with unparalleled depth and area
- RISE is a new Roman WFI program that will deliver deep stacks and value added analysis, and needs more work for science to be implemented successfully