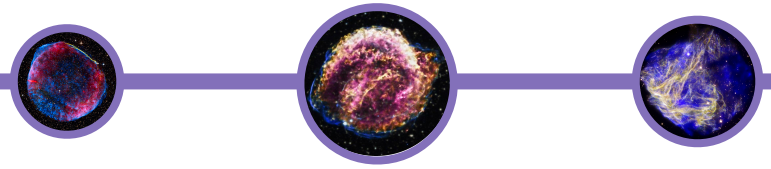
The Simulated Catalog of Optical Transients and Correlated Hosts (SCOTCH)



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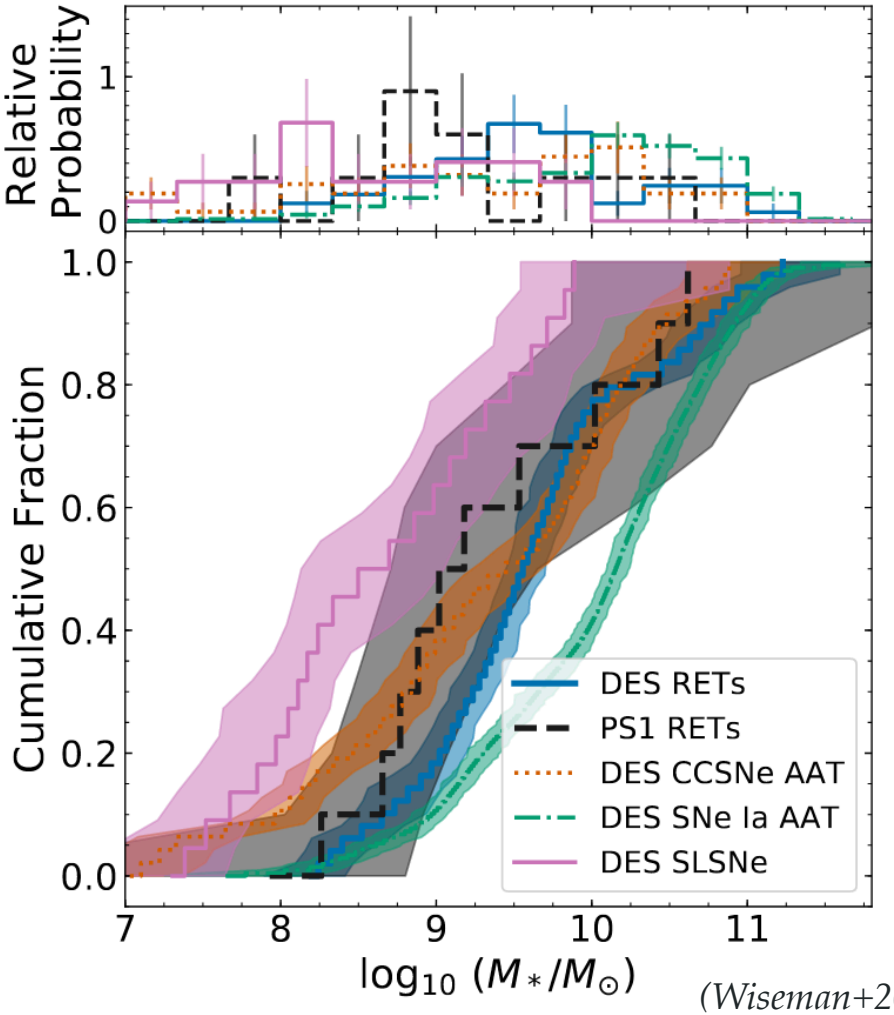
February 2021
Exploring the Transient Universe with Roman

The Value of Host-Galaxy Information in The Time-Domain



(Wiseman+2020)

Contextual information aids in

a. Classification
b. Progenitor studies
c. Cosmological constraints
d. Fast follow-up of relevant events

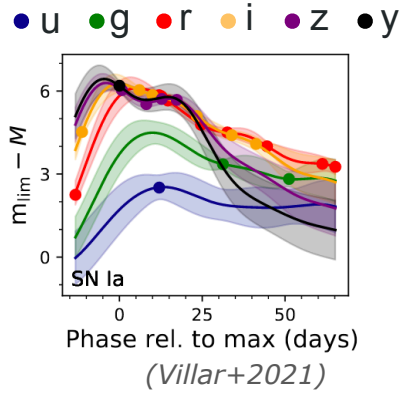
and will be crucial for understanding Rubin and Roman transients.

Extending the PLAsTiCC Challenge (Dec. 2018 - Feb. 2019)

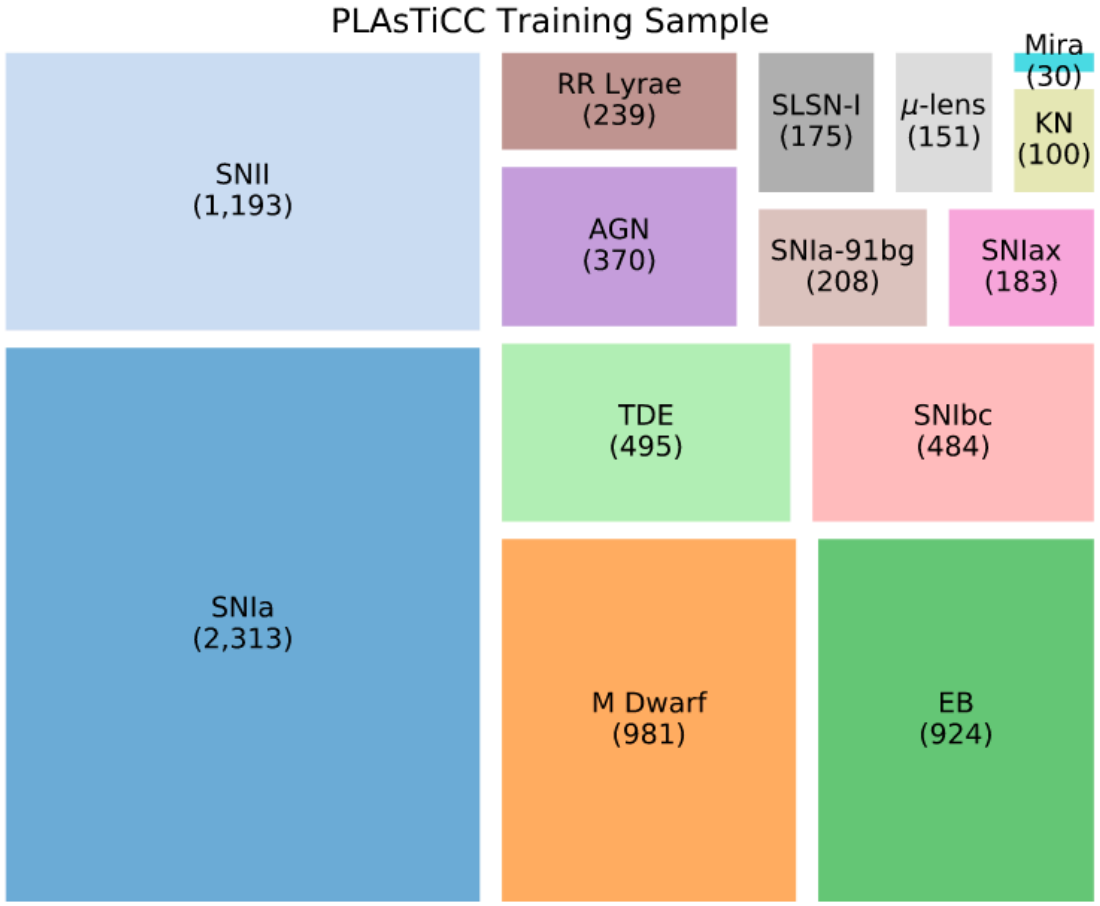
PLAsTiCC (2019)

Full-phase light curves to prepare classifiers for LSST

No host-galaxy correlations (host photo-zs only)



(Villar+2021)

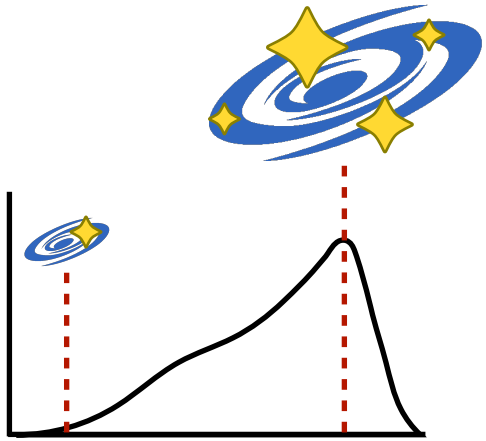


Increasing the Realism of High-z Transient Simulations

SCOTCH (2022)

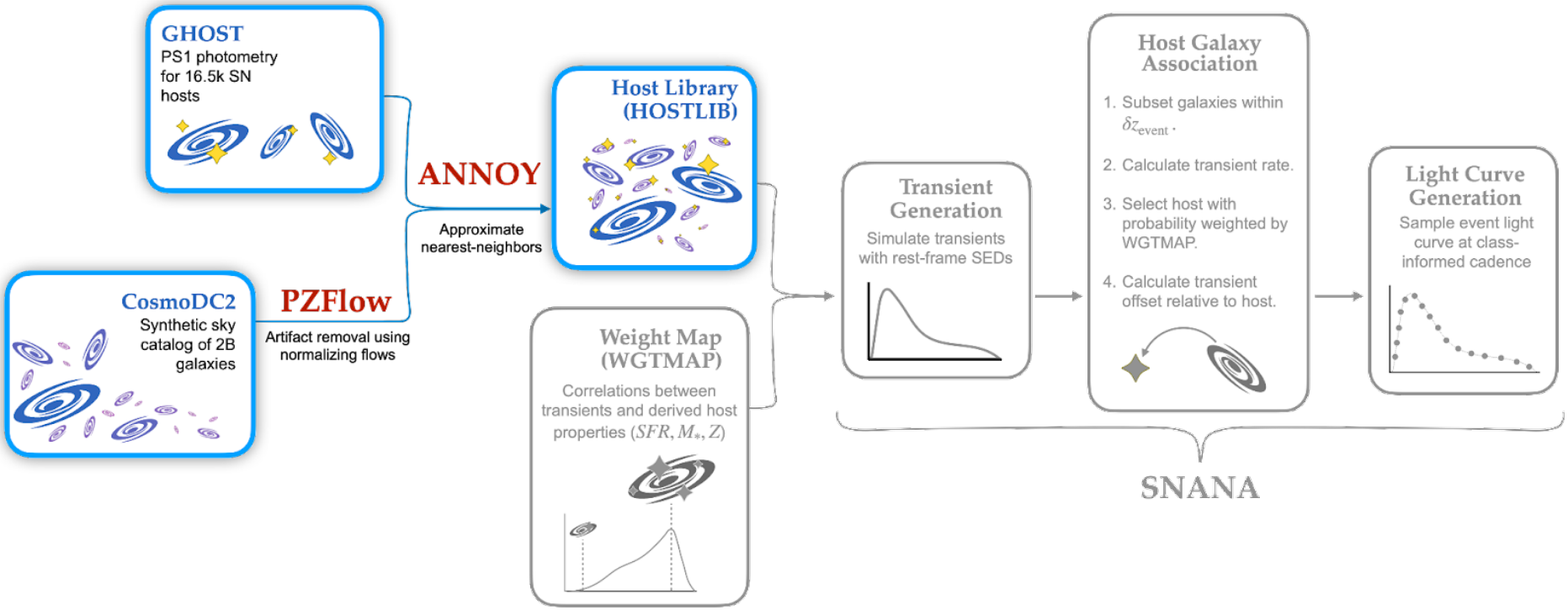
True photometry for 13 extragalactic transient classes (z<3)

Host association dependent on galaxy photometry (*griz*), color, M_*, *SFR*

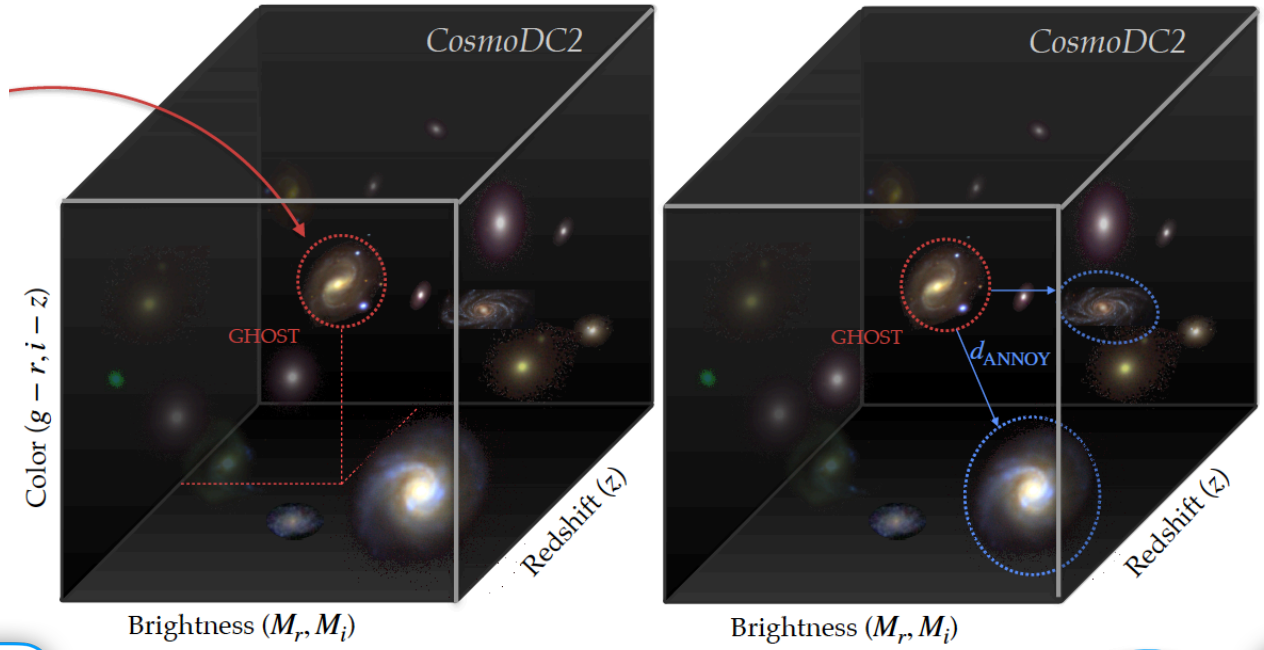


SN Ia (2M)				
SN II,IIn (2M)				
SN IIb (100k)	**SN Ib (100k)**	**SN Ic (100k)**	**SN II,IIn (100k)**	**SN Iax (100k)**
SLSN-I (100k)	**KN (100k)**	**AGN (100k)**	**TDE (100k)**	**SN 91bg (100k)**

Combining Observed Samples with Simulations



Generating A Library of 5M Transient Host Galaxies



*(Lokken, **Gagliano**, et al., 2022)*

PS1 photometry for 16.5k observed SN host galaxies *(Gagliano+2021)*

Galaxies drawn from ***CosmoDC2*** matching photometry of observed ***GHOST*** galaxies.

2B galaxies in 440 sq. deg simulation *(Korytov+2019)*

A List of Host Libraries By Transient Class

SN Ia Hosts

SN II Hosts

II, IIP, IIL, IIn

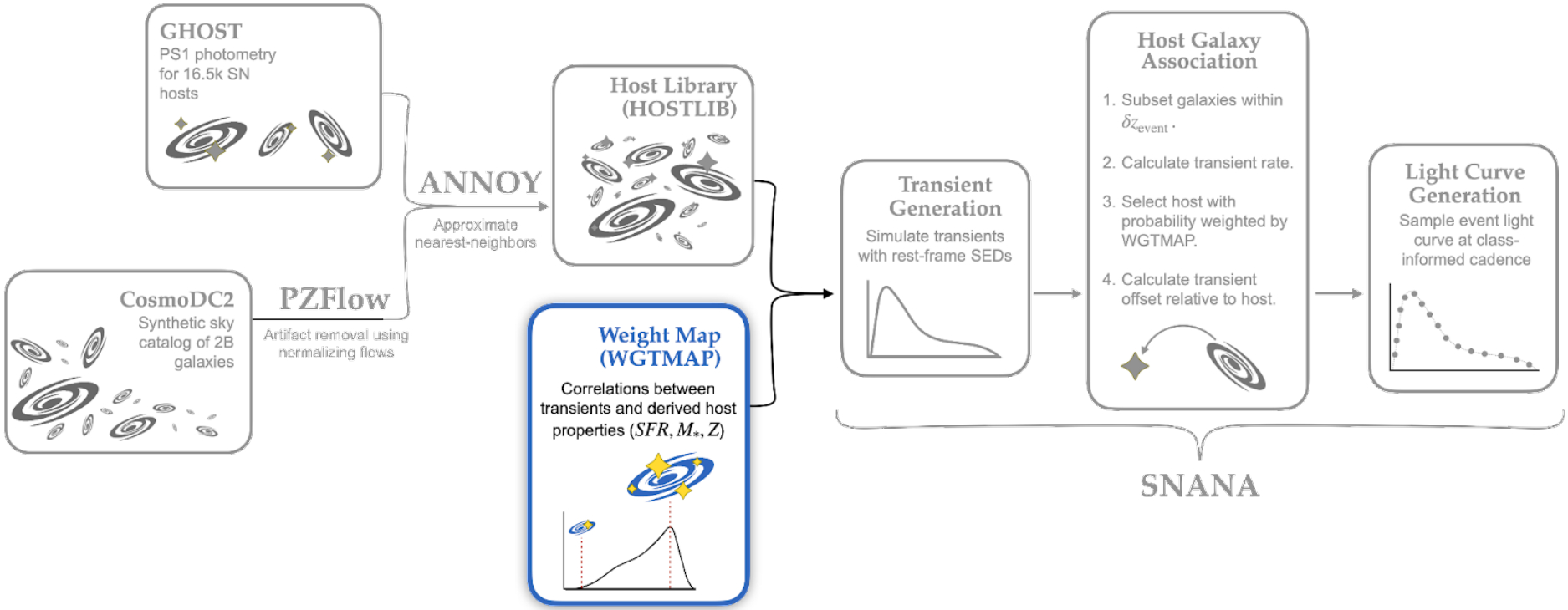
H-poor SN Hosts

Ib, Ic, Ic-BL, SLSN-I, IIb

Random DC2 Subset

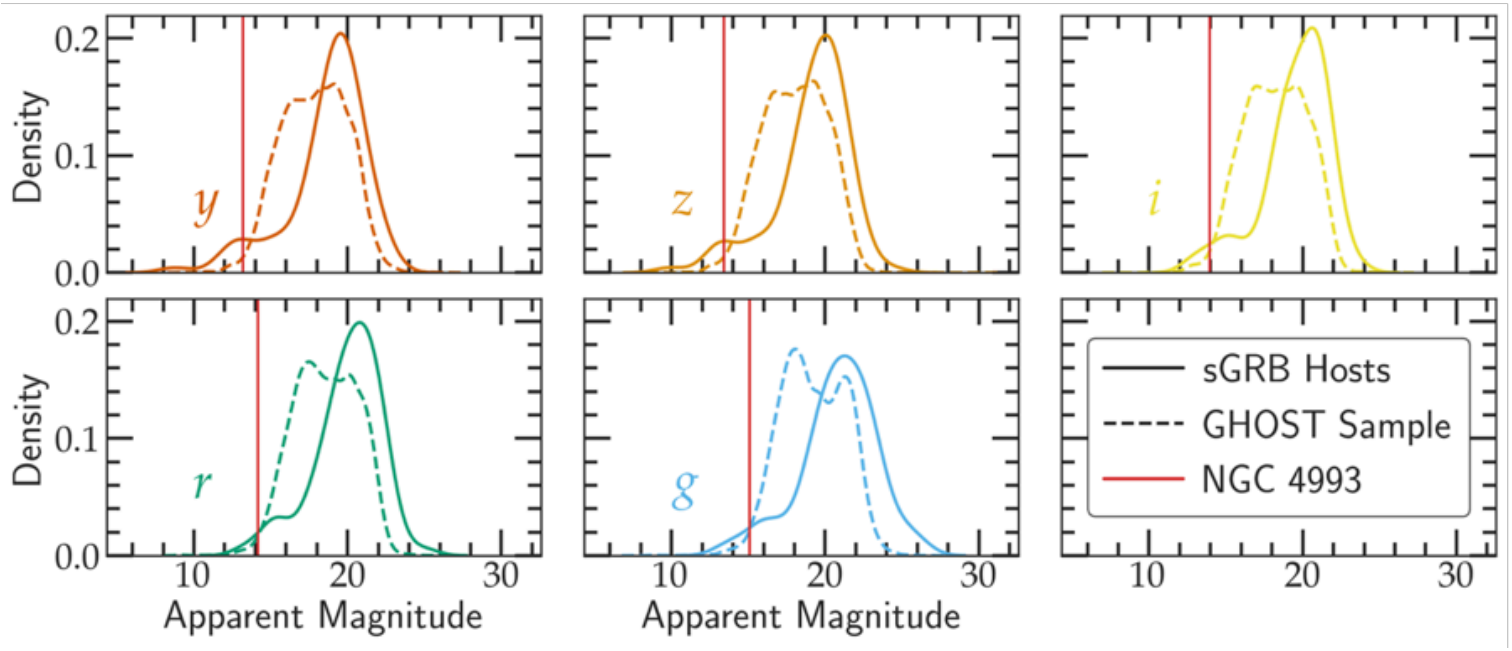
AGN, TDE, KN

Correlating Transients with Derived Host-Galaxy Features



Leveraging sGRB Samples to Prepare for the next Kilonova Event

Using sGRBs as a proxy for KNe-host galaxy correlations:

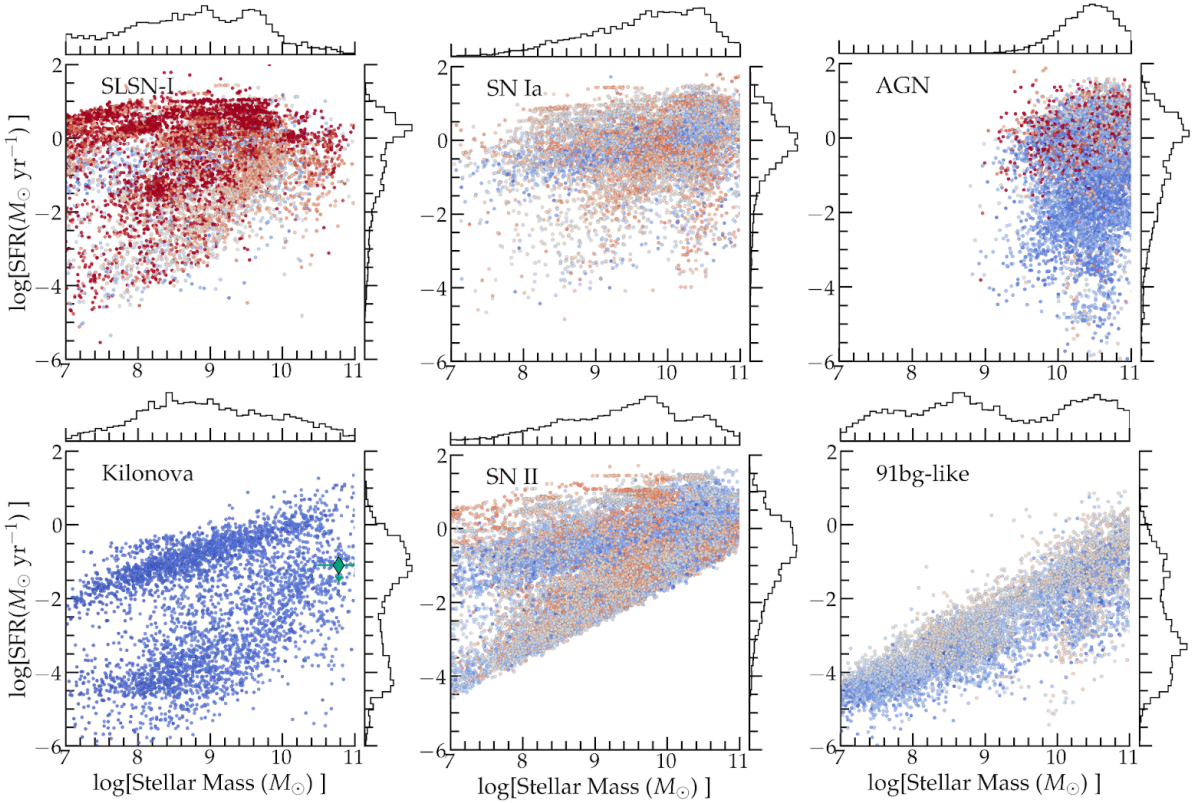


Laura Salo

PhD Candidate,

University of Minnesota

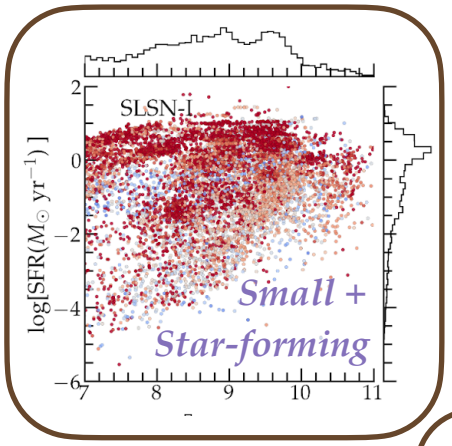
Validating Synthetic Host-Galaxy Correlations: M_* and SFR

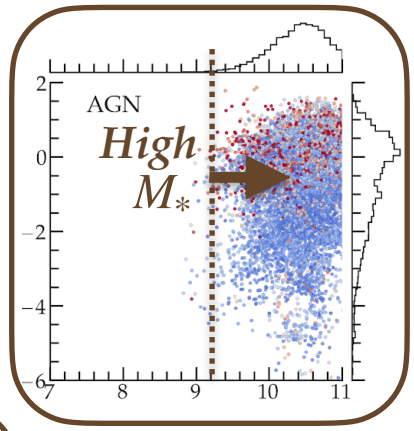


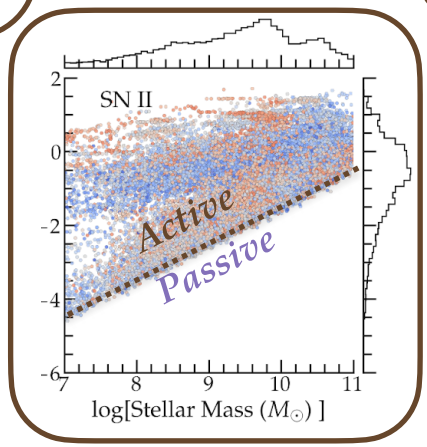
Host selection from **host library** weighted by class-specific **weight map**

Weight maps encode **derived** host-galaxy correlations (M_*, SFR)

Validating Synthetic Host-Galaxy Correlations: M_* and SFR







Host selection from **host library** weighted by class-specific **weight map**

Weight maps encode **derived** host-galaxy correlations (M_*, *SFR*)

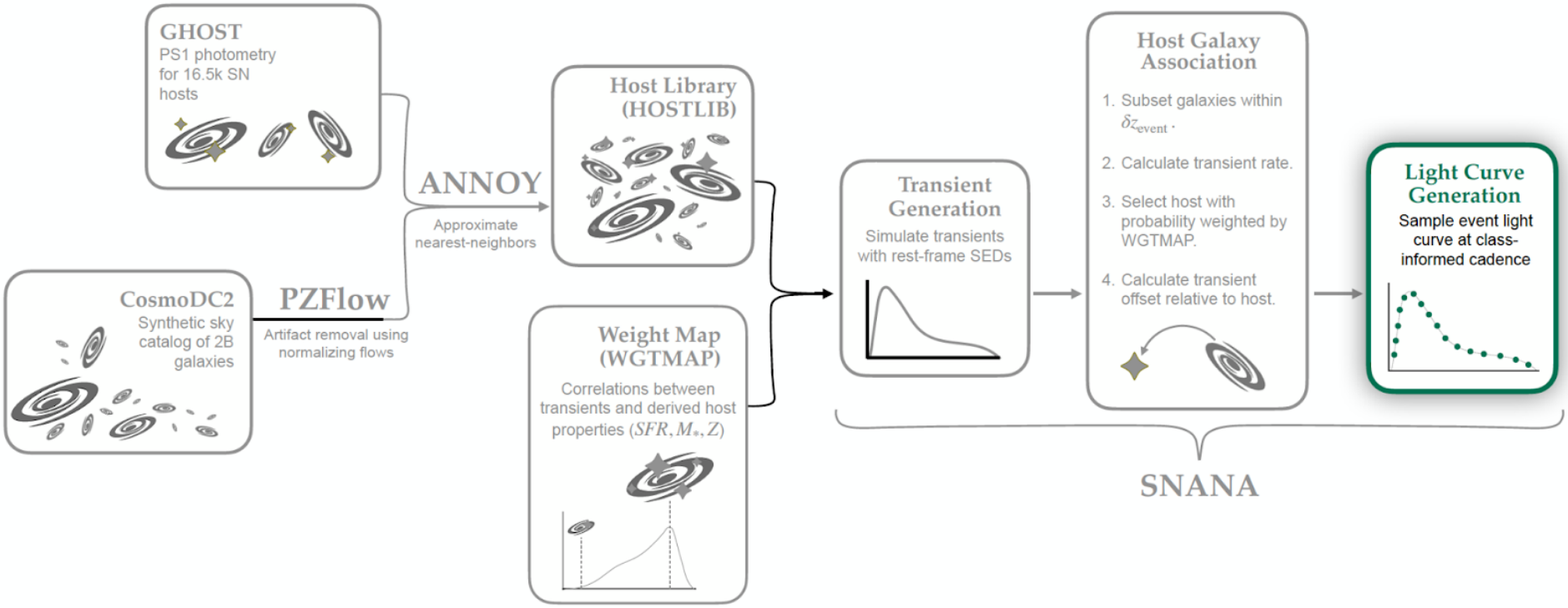
SLSNe-I found in **low-mass, blue galaxies***, SNe II (core-collapse) in **active galaxies****, and AGN in **massive galaxies*****.

**Perley+2016, Wiseman+2020*

***Kelly+2012*

****Kauffmann+2003*

Light Curve Generation: An Overview



Properties of Idealized Transient Light Curves

Transient photometry is

High-cadence:

Regular 2-day for most classes

Variable for rapidly-evolving transients (KN)

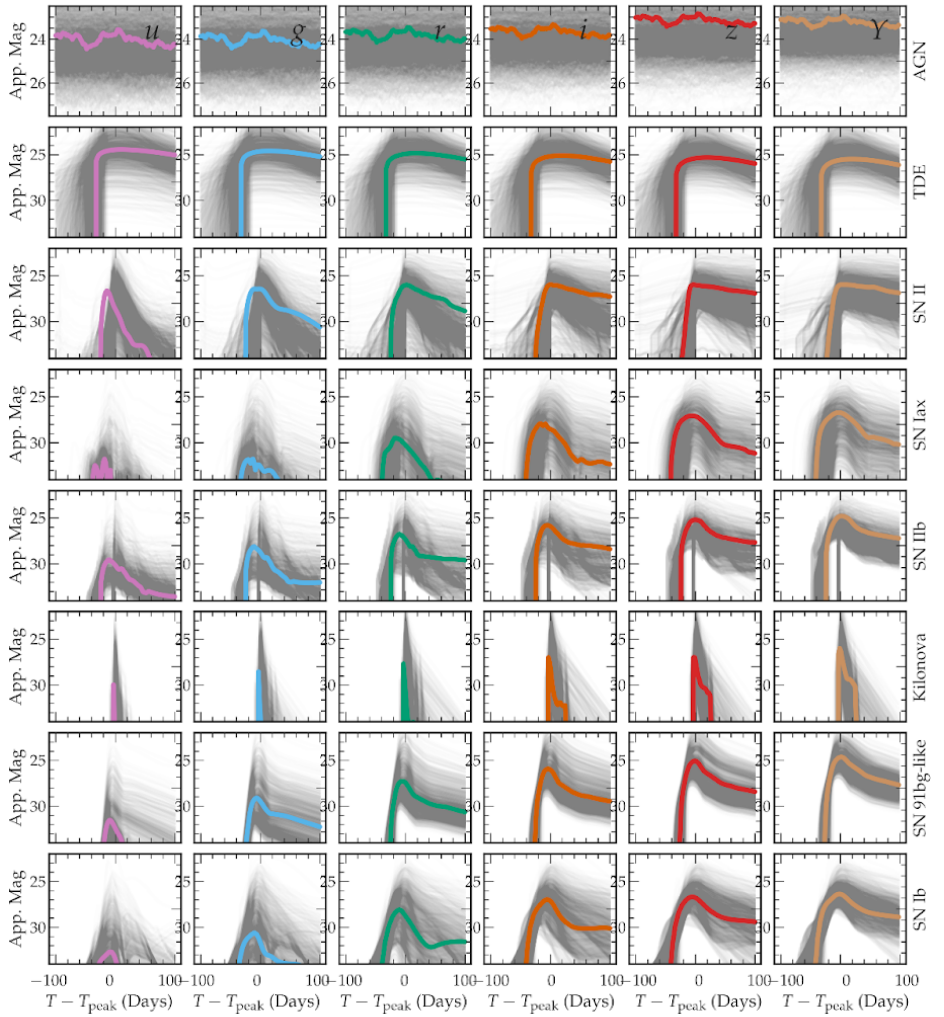
Top-of-the-galaxy:

No atmosphere

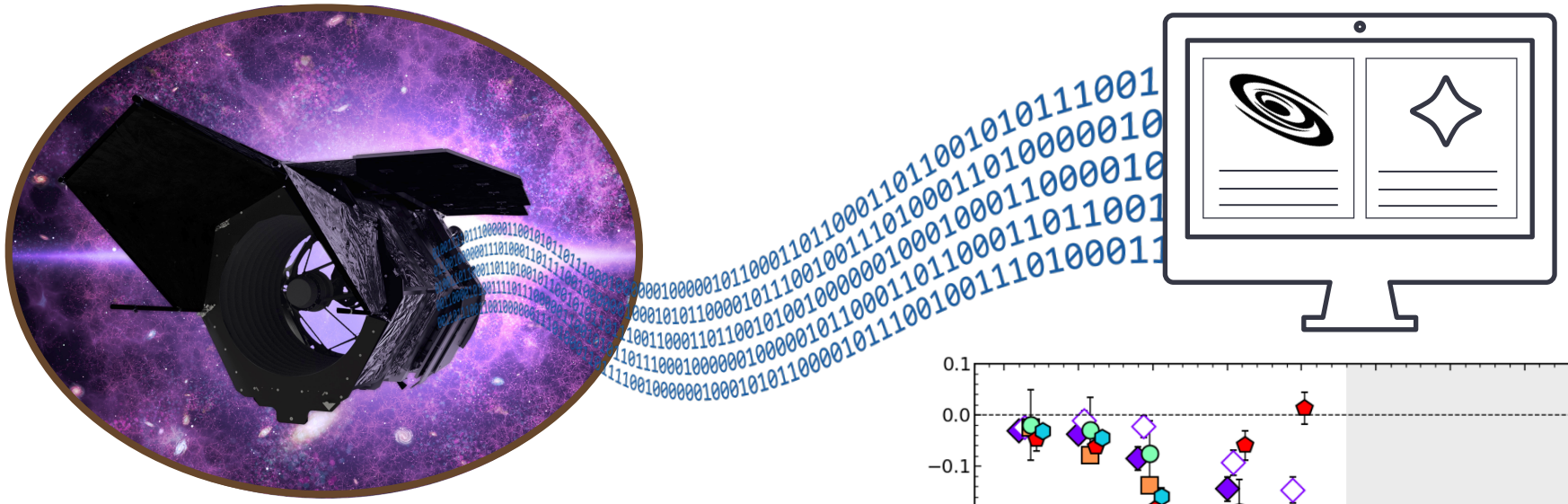
No Galactic extinction

Host-extincted

Transients also placed at realistic offsets from their host galaxies.



Exploring The Transient (+Host) Universe With Nancy Grace Roman



Correlations at high-z:

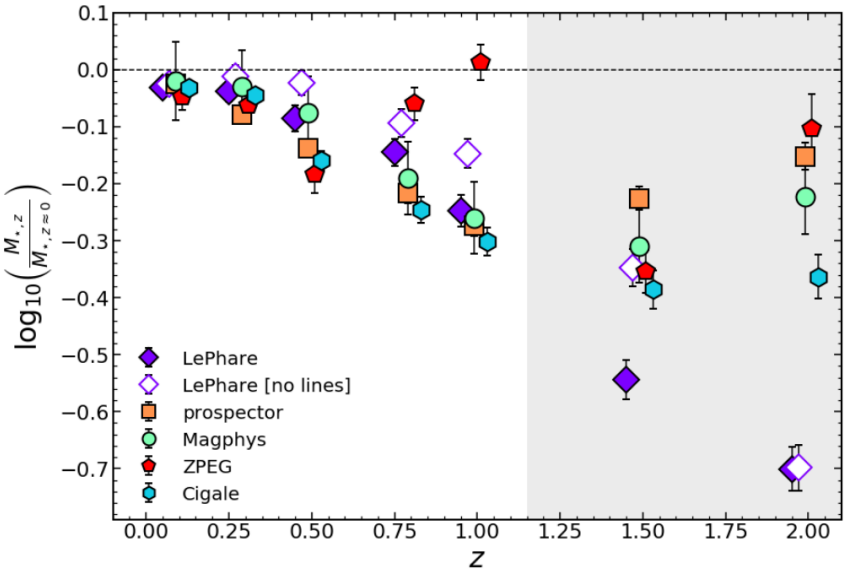
>12k SNe Ia at z>1

(WIDE+DEEP; Rose+2021)

z-evolution?

Correlations in the NIR:

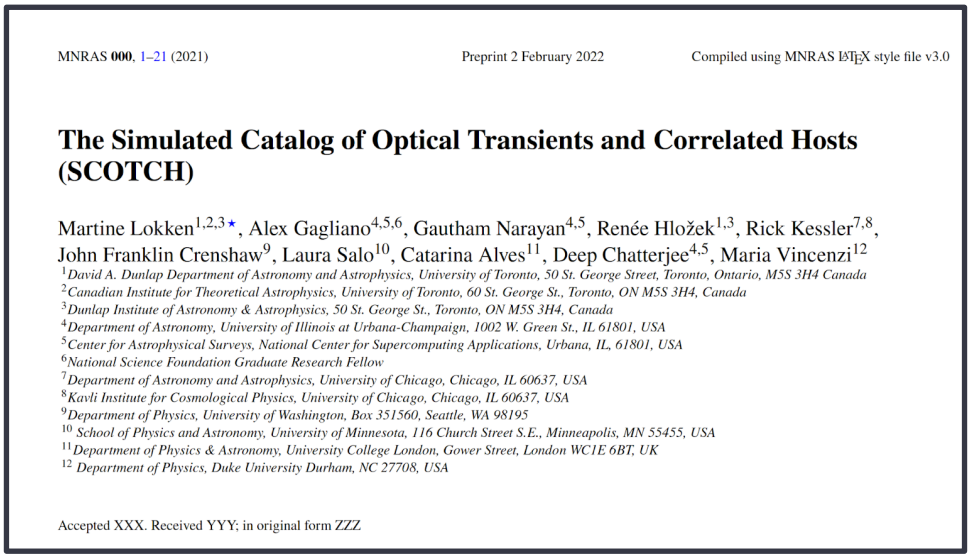
Tighter constraints on host M_*, *SFR*



Paulino-Afonso+2022 (yesterday!)

Conclusion: SCOTCH For Upcoming Time-Domain Surveys

Catalog of 5M optical transients of 13 extragalactic classes (z<3) with realistic host-galaxy properties. Paper in collaboration-wide review!



MNRAS 000, 1–21 (2021) Preprint 2 February 2022 Compiled using MNRAS LATEX style file v3.0

The Simulated Catalog of Optical Transients and Correlated Hosts (SCOTCH)

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Accepted XXX. Received YYY; in original form ZZZ

*(Lokken, **Gagliano**, et al., 2022)*

1. Simulations are **survey-agnostic***
   **except for the LSST ugizy bands*
2. Host libraries, weight maps, and associated software **open-source**
3. Same host-association used for **ELAsTiCC,** with LSST-specific exposure time, footprint, and cadence.