Catalog-level Simulations of a High Latitude Time Domain Survey for the Nancy Grace Roman Space Telescope

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+ Foley SIT

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Roman Science Team Community Briefing 11/18

Goal (for talk)

- Describe how catalog-level simulations are generated, how they are being used to prepare for Roman, and describe ongoing/future work

Motivation (post Hounsell et al. 2018)

- updates to hardware and Roman capabilities are non-trivial to propagate to cosmology results (e.g. slew/settle time, filter throughputs)
- ongoing work to quantify systematic effects on cosmological inferences
- decisions remain to be made for major survey choices (e.g. fraction of time dedicated to spectroscopy)
- preparatory work for synergy with existing and future facilities
- variations / optimization

SIMULATIONS OF THE *WFIRST* SUPERNOVA SURVEY AND FORECASTS OF COSMOLOGICAL CONSTRAINTS

H18 paper

R. Hounsell,[1,2] D. Scolnic,[3] R. J. Foley,[1] R. Kessler,[3] V. Miranda,[4] A. Avelino,[5] R. C. Bohlin,[6] A. V. Filippenko,[7,8] J. Frieman,[3,9] S. W. Jha,[10] P. L. Kelly,[11] R. P. Kirshner,[5,12] K. Mandel,[5,13,14] A. Rest,[6,15] A. G. Riess,[6,15] S. A. Rodney,[16] and L. Strolger[6]

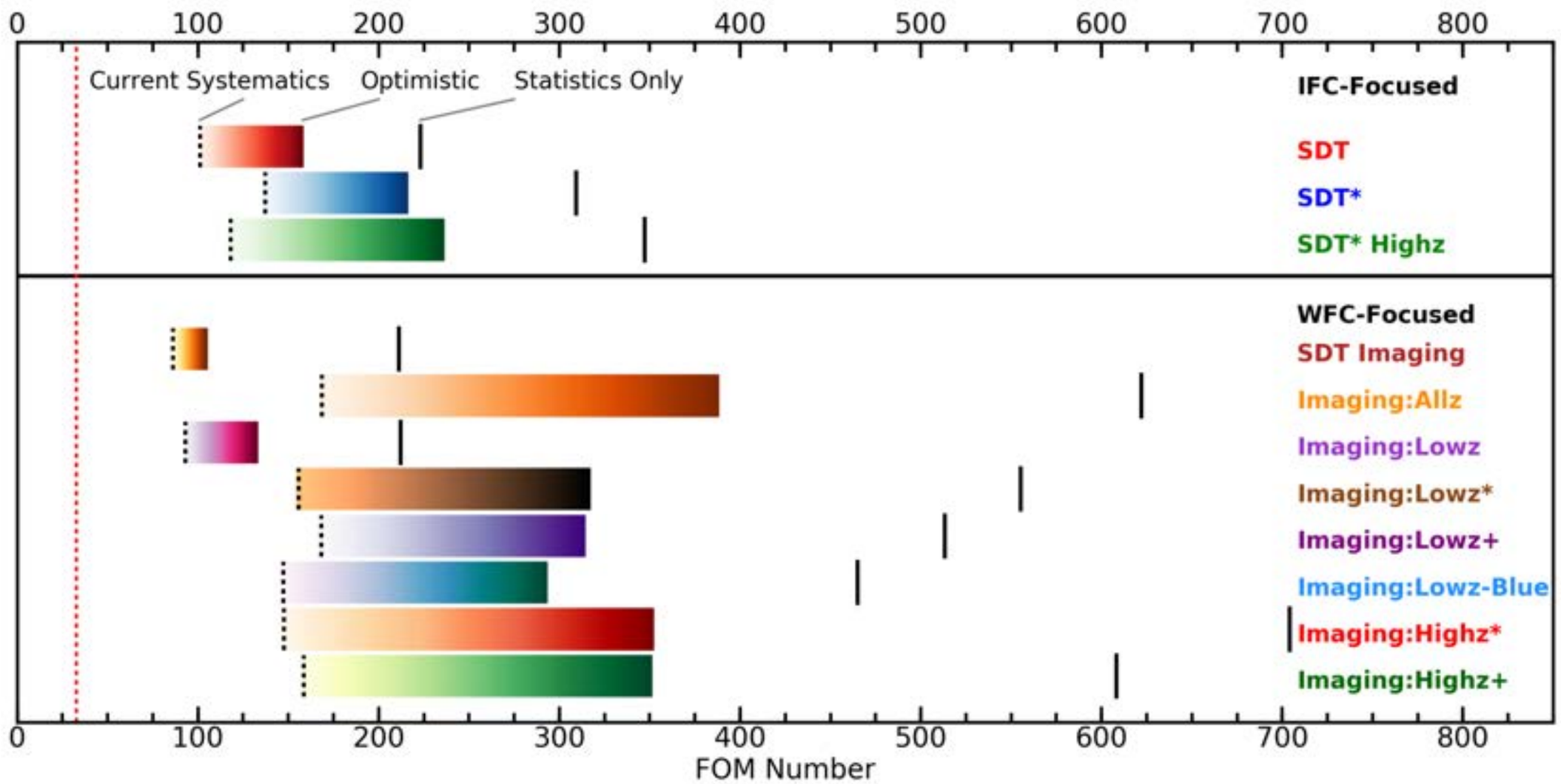
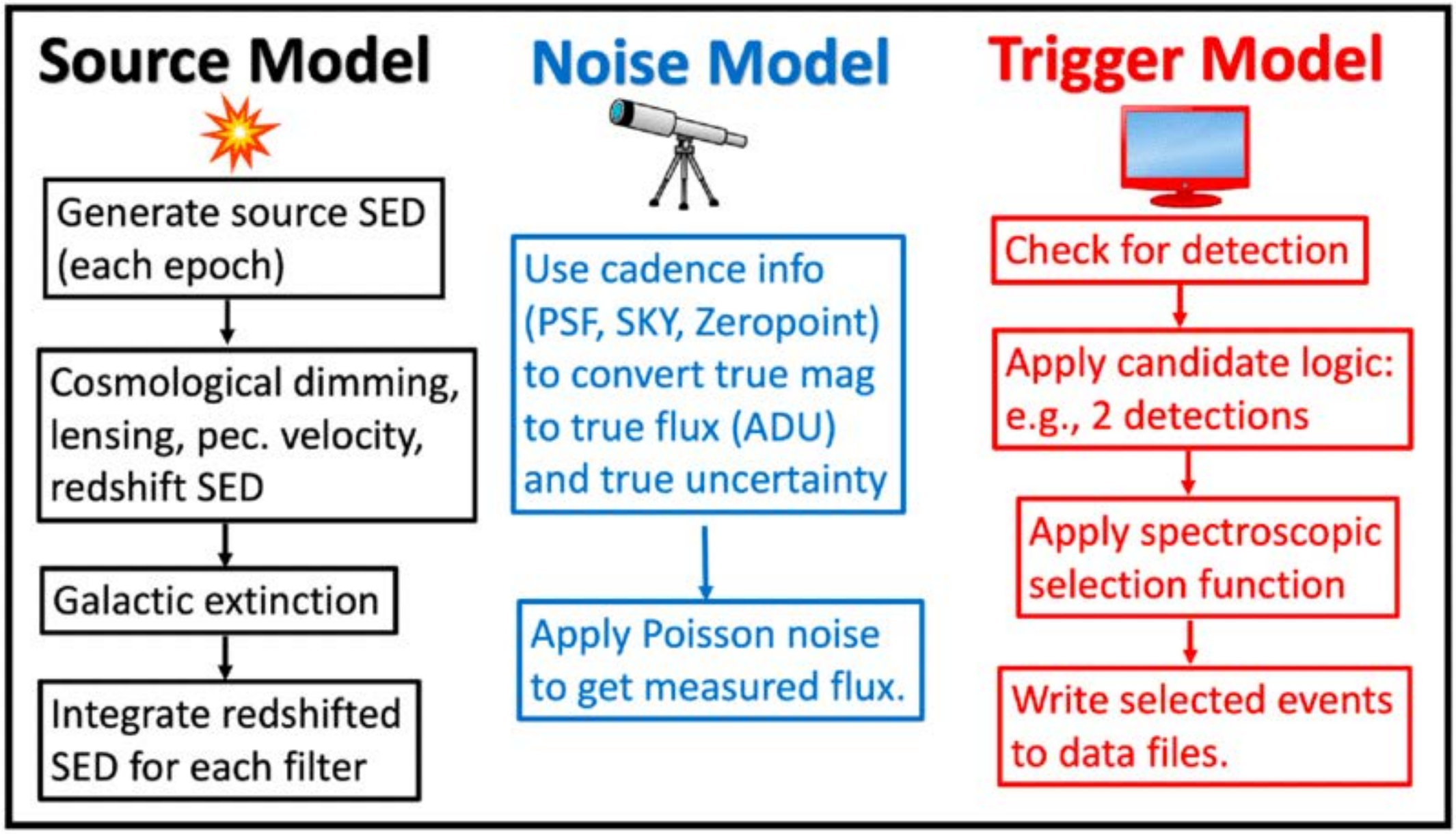


Figure 12. Predicted dark energy FoMs for the simulated *WFIRST* SN survey strategies outlined in Section 5. IFC-focused and WFC-focused strategies are presented in the top and bottom panels, respectively. The gradients for each strategy represent the range of FoMs from $\mathrm{FoM}_{\mathrm{tot,curr}}$ (dotted lines) to $\mathrm{FoM}_{\mathrm{tot,opt}}$. The thick black lines represent $\mathrm{FoM}_{\mathrm{stat}}$. The red dashed vertical line indicates the current FoM value of 32.6 (Alam et al. 2016).

The Supernova Analysis Package (SNANA)



https://github.com/RickKessler/SNANA

Image: R. Kessler

Pippin Pipeline for Supernova Survey Analysis

https://github.com/Samreay/Pippin

survey level choices: cadence, depth, filters, tiers, fields

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             FOUNDfit_BIAS_FOUND_BIASCOR_G10
CLASSIFY     FITPROBTEST   FITPROBTEST
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             MERGE_FOUNDfit_SIM_FOUND_SIMDATA_G10   MERGE_FOUNDfit_BIAS_FOUND_BIA
BIASCOR      BBC
CREATE_COV   NGRST_COV_BBC
COSMOMC      SN_BANANA_OMW_NGRST_COV_BBC
ANALYSE      BANANA_OMW
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        SNANASimulation FOUND_SIMDATA_G10 task (wall time 1:02:04, 1 jobs, deps
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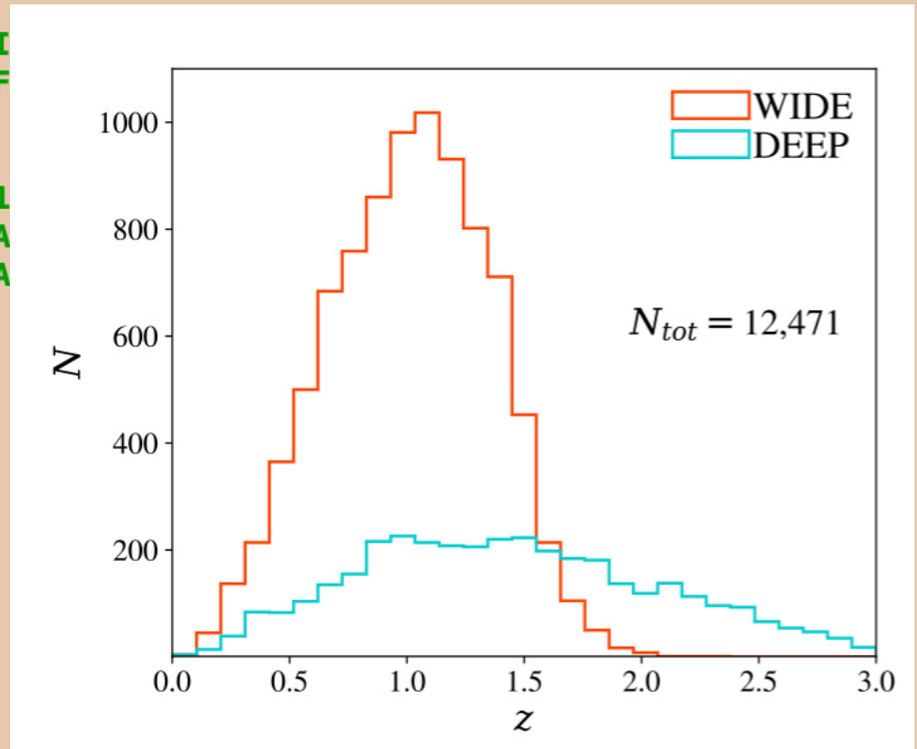
1: simulate LCs (output in catalog form)



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            FOUNDfit_BIAS_FOUND_BIASCOR_G10
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BIASCOR     BBC
CREATE_COV  NGRST_COV_BBC
COSMOMC     SN_BANANA_OMW_NGRST_COV_BBC
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        SNANALightCurveFit FOUNDfit_BIAS_FOUND_BIASCOR_G10 task (wall time 0:
        FitProbClassifier FITPROBTEST task (wall time 0:00:00, 1 jobs, deps [
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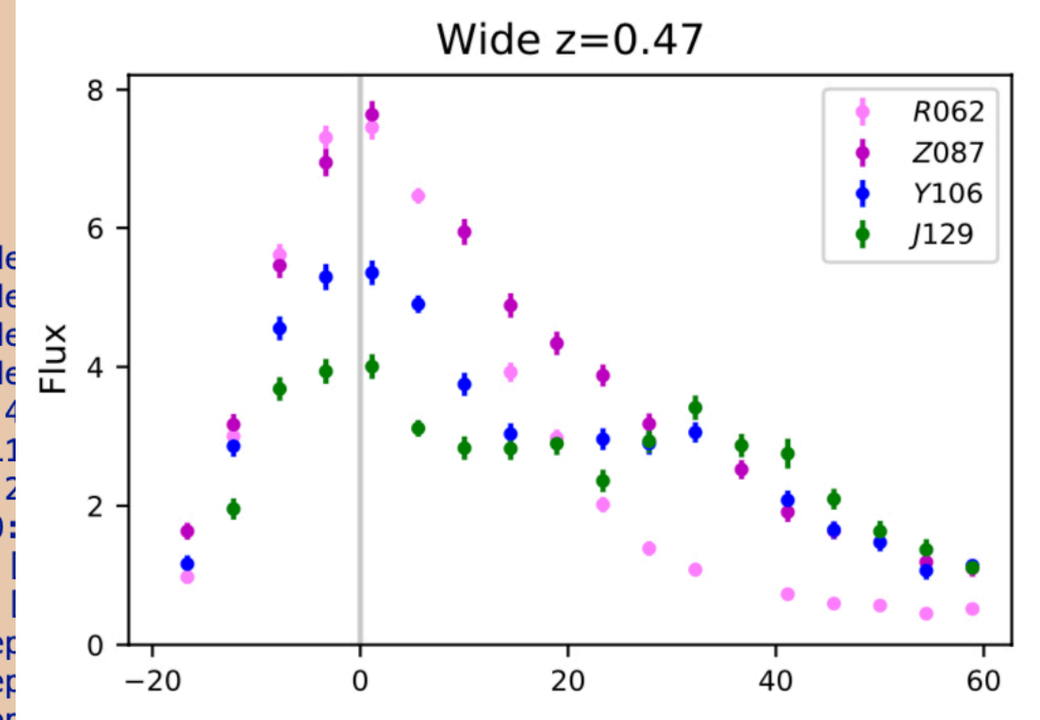
2: fit light-curves



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        SNANASimulation FOUND_SIMDATA_G10 task (wall
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        SNANALightCurveFit NGRSTfit_BIAS_NGRST_BIASCO
        SNANALightCurveFit FOUNDfit_SIM_FOUND_SIMDATA_
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        Aggregator AGG_NGRST_BIASCOR_G10 task (wall t
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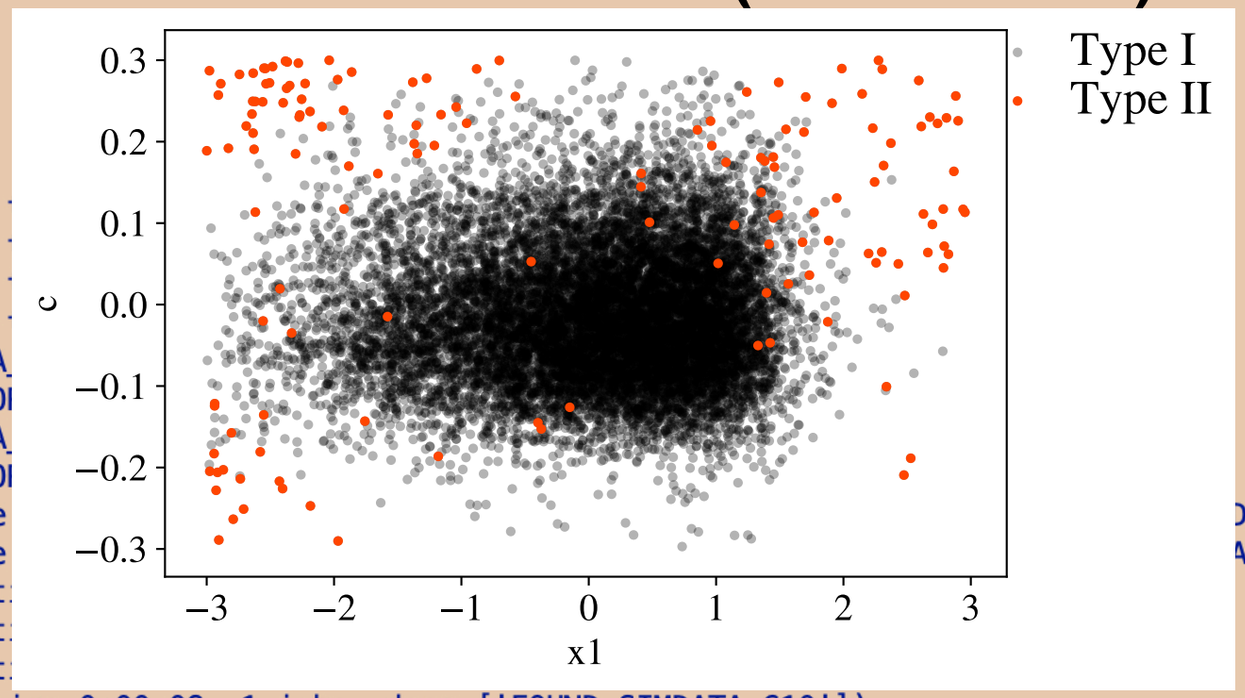
3: transient classification (Helen's talk!)



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CREATE_COV  NGRST_COV_BBC
COSMOMC     SN_BANANA_OMW_NGRST_COV_BBC
ANALYSE     BANANA_OMW
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BBC paper

6: calculate distances, produce HD

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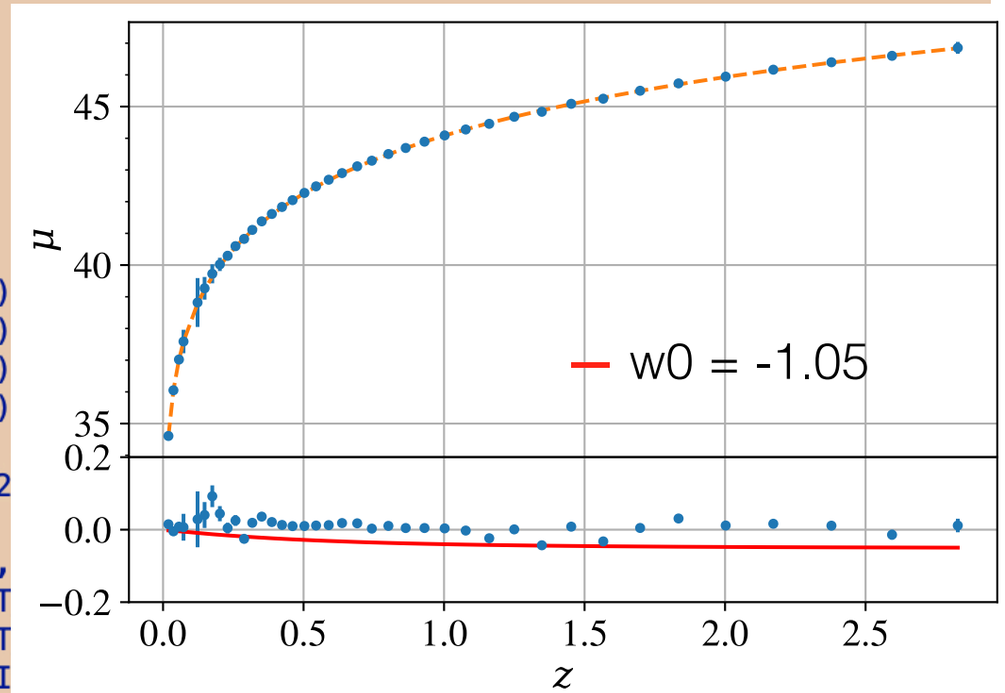

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             FOUNDfit_BIAS_FOUND_BIASCOR_G10
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             MERGE_FOUNDfit_SIM_FOUND_SIMDATA_G10   MERGE_FOUNDfit_BIAS_FOUND_
BIASCOR      BBC
CREATE_COV   NGRST_COV_BBC
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ANALYSE      BANANA_OMW
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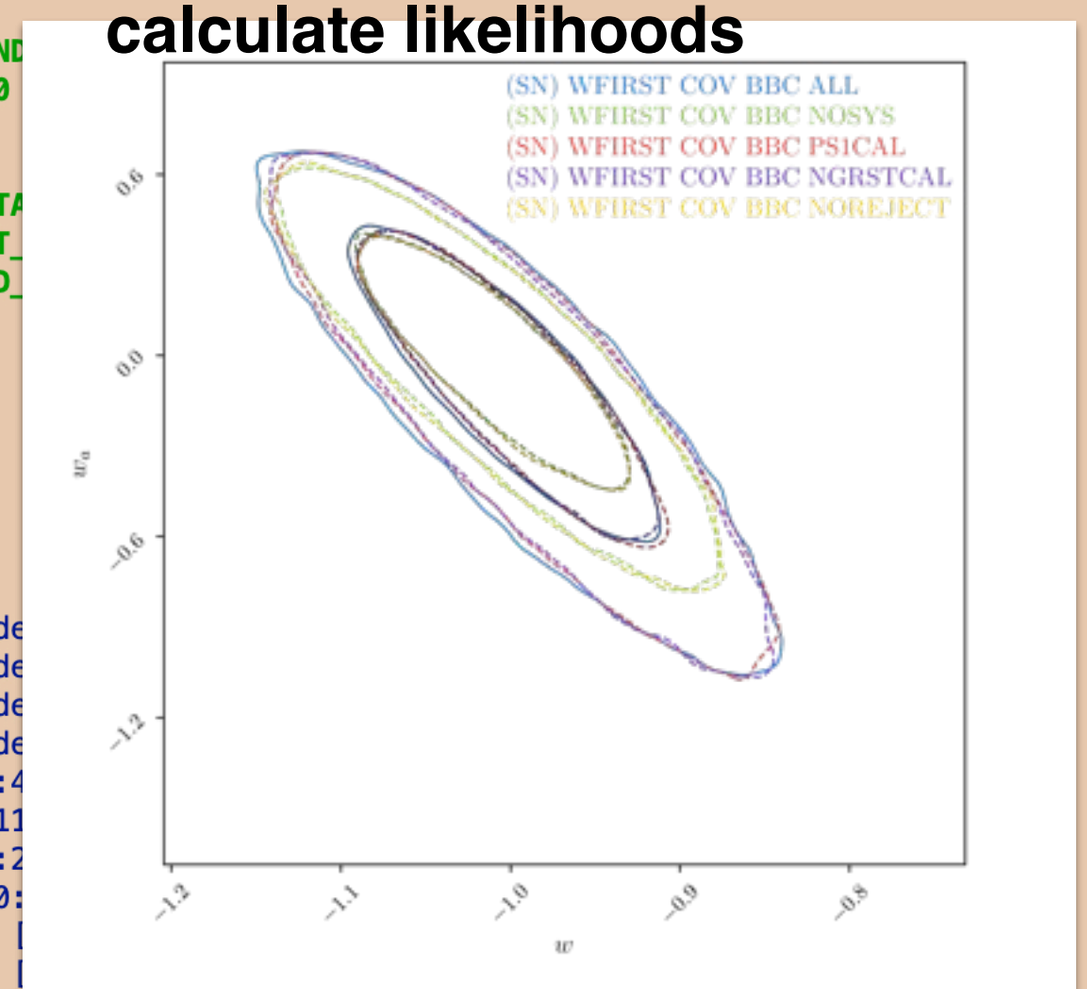
8+9: explore cosmological-parameter space, calculate likelihoods



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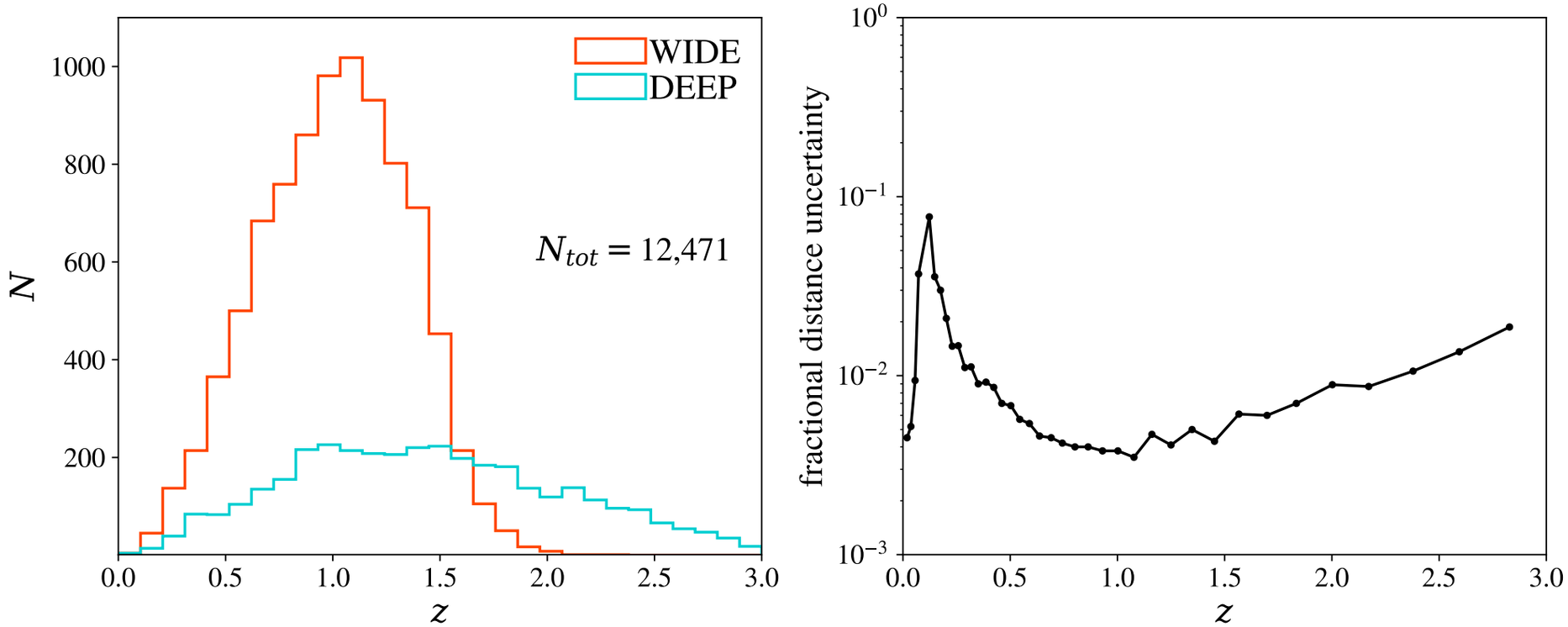
Mode	Tier	$z_{\rm targ}$*	Filters	Exp.Time+Overhead (s)	No. of Pointings	Area (deg^2)	Time/Visit (hours)	Total SN Ia
25% Spectroscopy Survey								
Imaging	Wide	1.0	RZYJ	160;100;100;100 + 70x4	68	19.04	14.0	8804
Imaging	Deep	1.7	YJHF	300;300;300;900 + 70x4	15	4.20	8.5	3520
Subtotal							**22.5**	**12324**
Spec	Wide	1.0	prism	900 + 70	12	3.36	3.2	831
Spec	Deep	1.5	prism	3600 + 70	4	1.12	4.1	652
Subtotal							**7.3**	**1483**

*$z_{\rm targ}$ denotes the redshift where the average SN Ia at peak is observed with S/N=10 per exposure.

Table 1. The 25% reference survey strategy

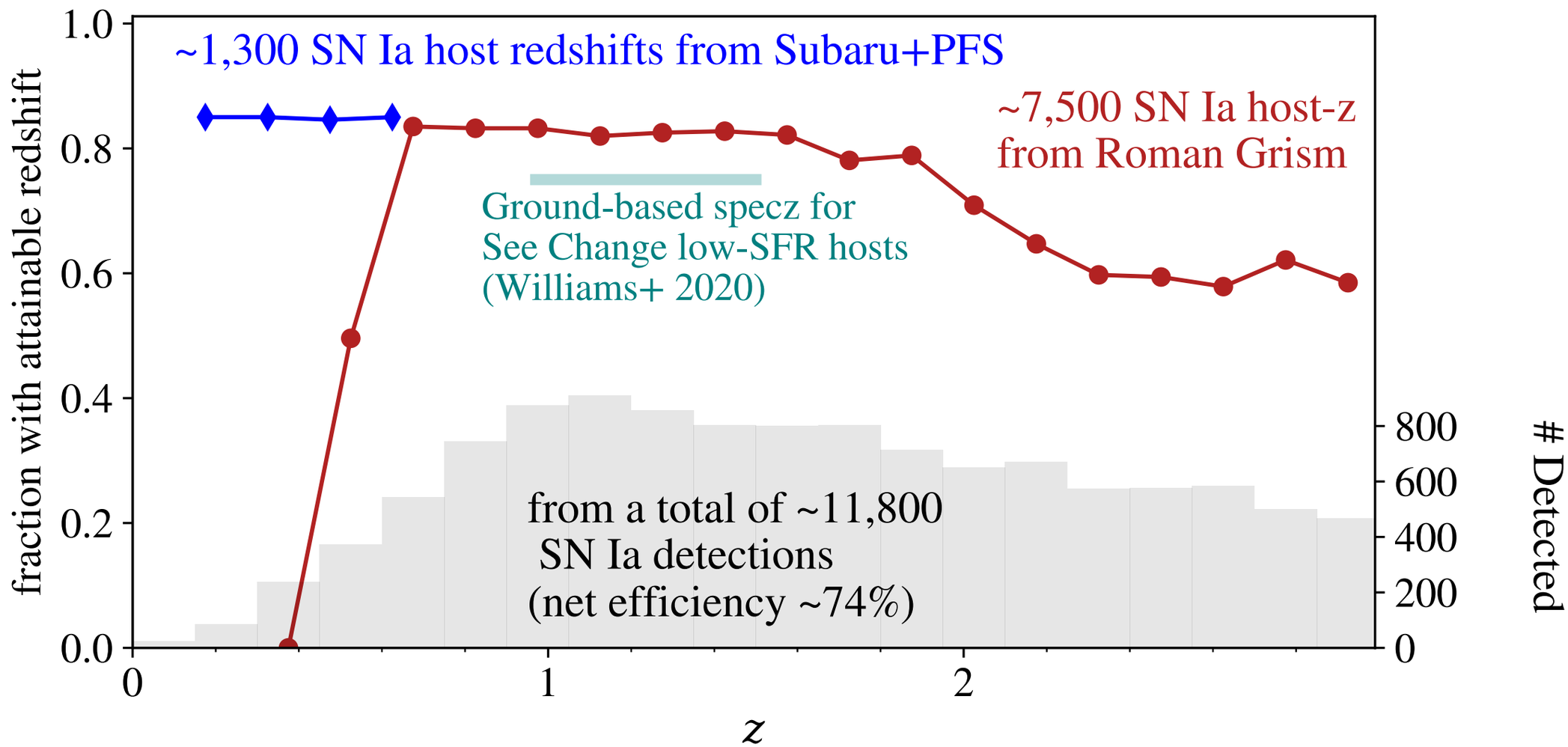
FoM requirements met



details can be found in arXiv:2111.03081

Redshift Acquisition

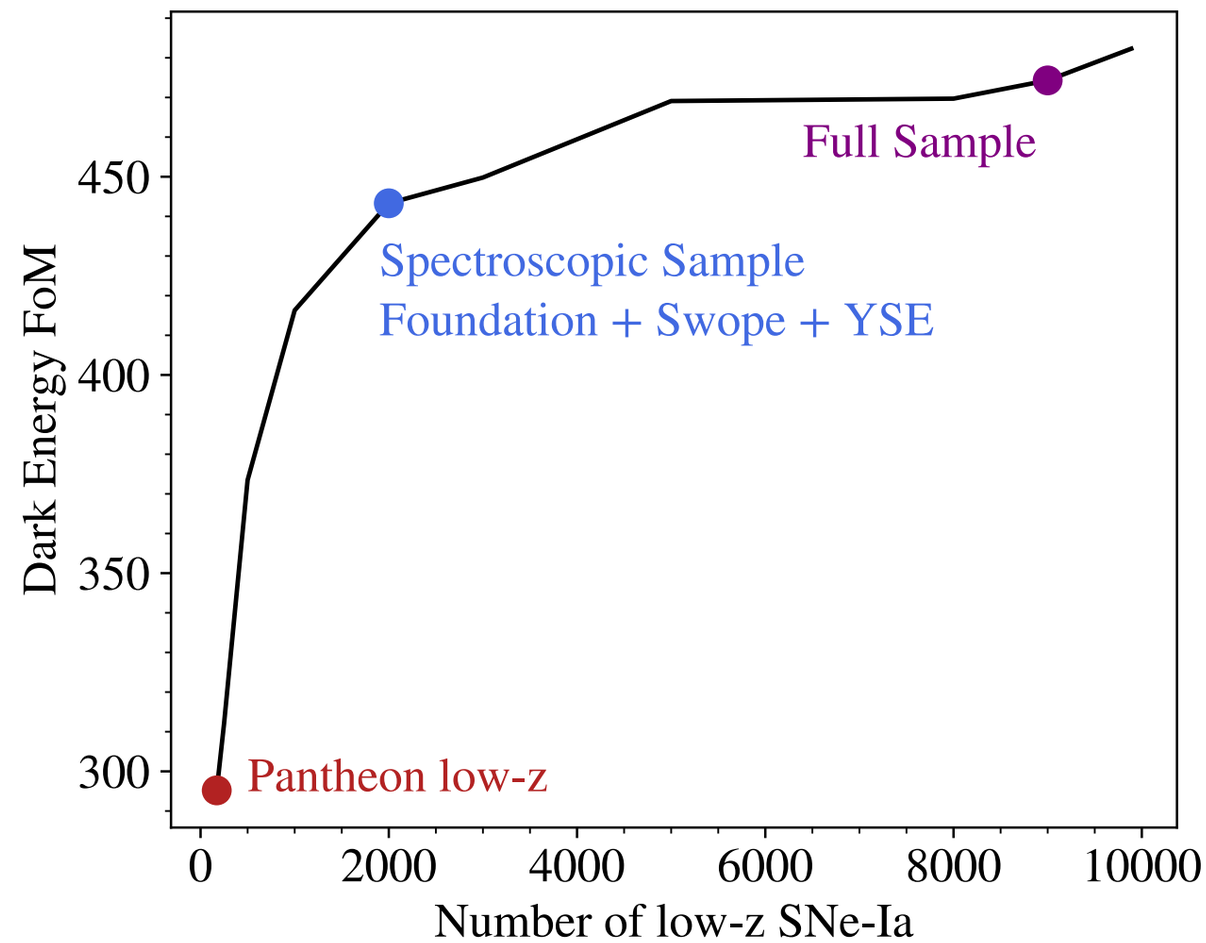
based on existing and future (Roman HLS, Euclid) galaxy catalogs, we can estimate fraction of host-galaxies that will have a redshift attainable without HLTDS spectra



Low-z Sample

- low-z sample is necessary to “anchor” Hubble Diagram

- at ~5k SNe this sample saturates in its cosmological utility (systematics limited)



pmacias@ucsc.edu

Macias et al., in-prep

+ lots more work in progress!