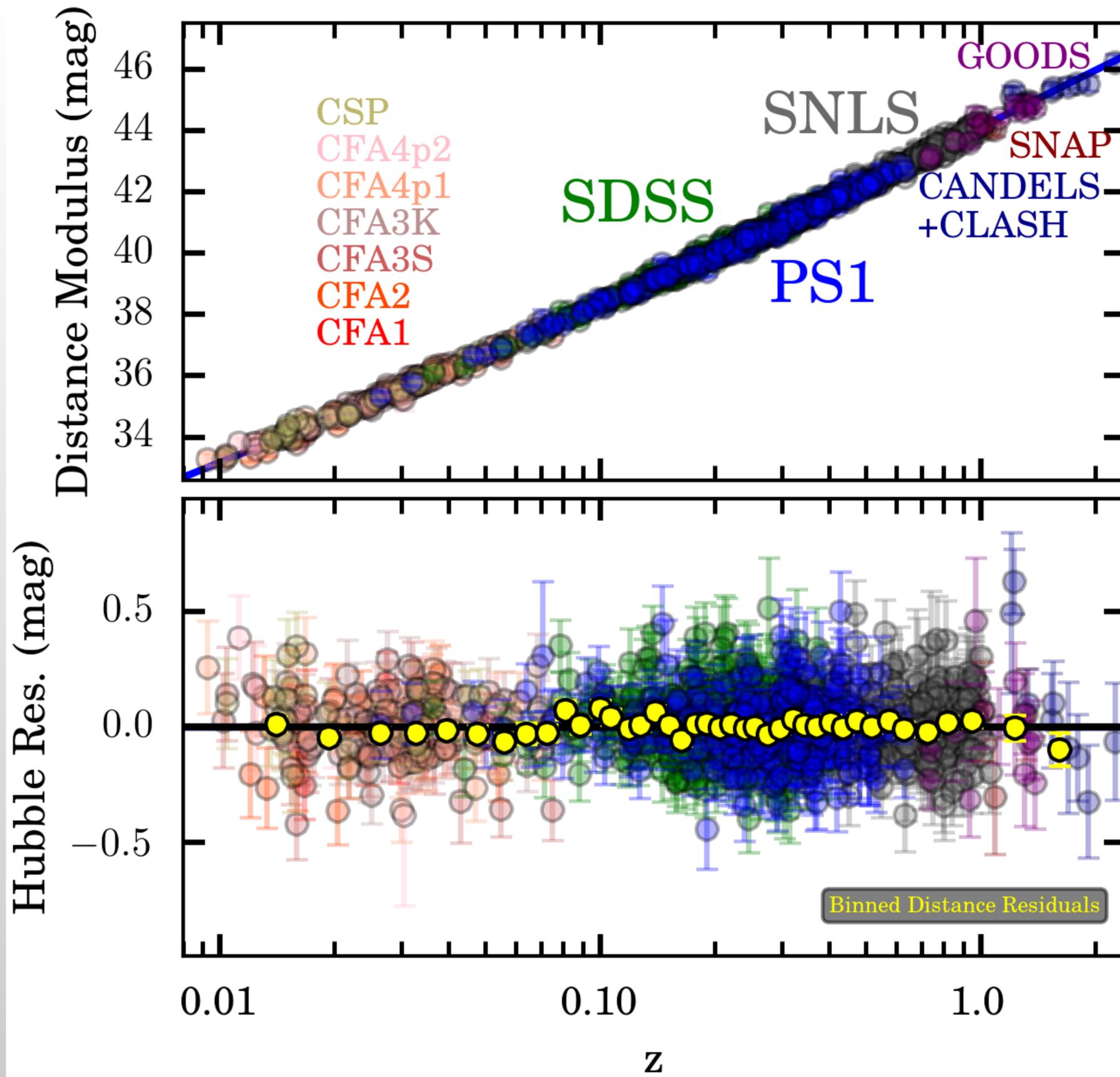


Breaking through the Nearby Barrier

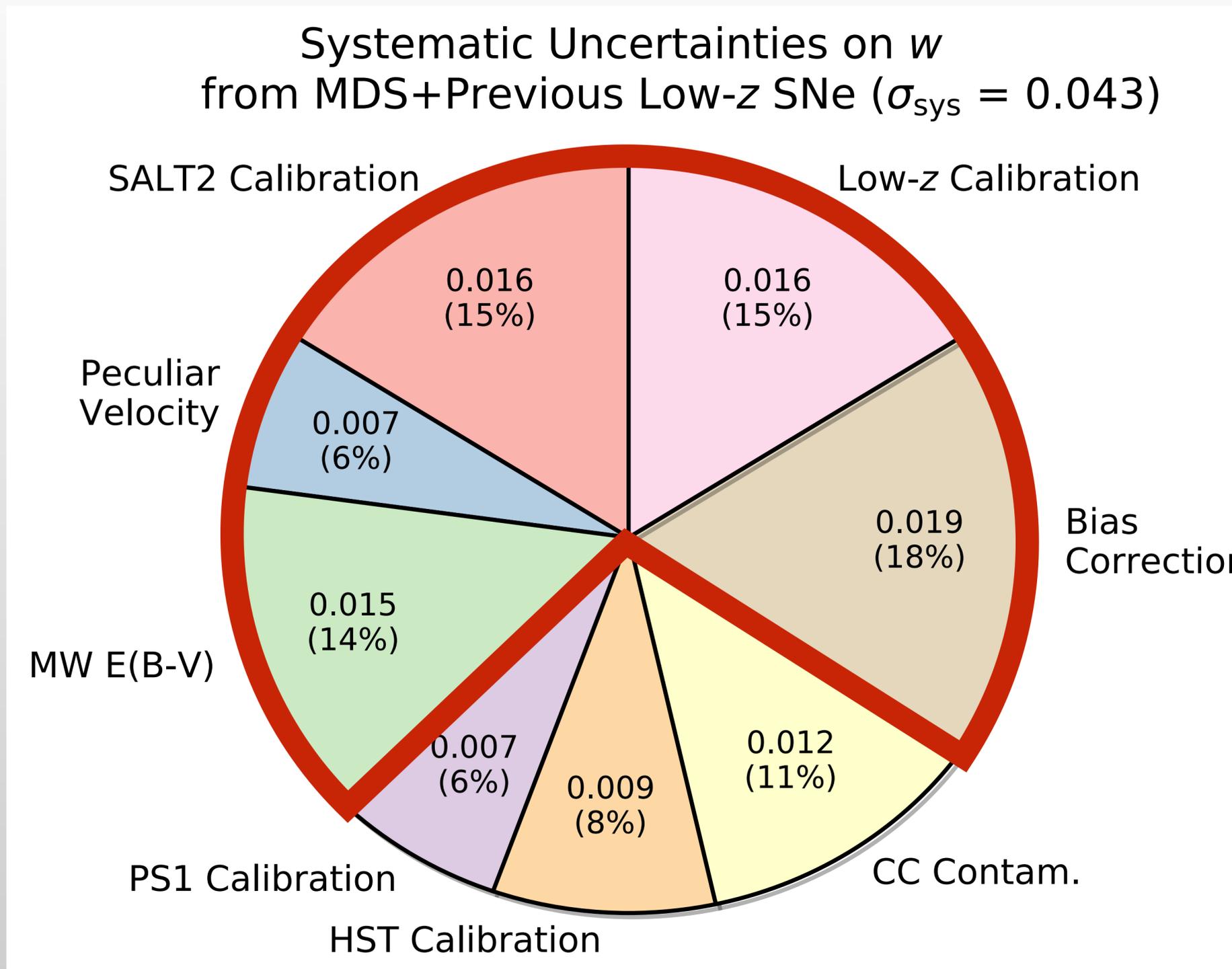


Ryan Foley
UC Santa Cruz

Dave Coulter, Georgios Dimitriadis,
David Jones, Charlie Kilpatrick,
César Rojas-Bravo, **Matt Siebert** (UC Santa Cruz),
Dan Scolnic (Duke), Ori Fox, **Elizabeth Johnson**,
Armin Rest, Adam Riess (STScI/JHU), Yen-Chen Pan (NAOJ),
Bob Kirshner (Moore), Mi Dai, **Kyle Dettman**, Saurabh Jha (Rutgers),
Gautham Narayan (Illinois), Rick Kessler (KICP), **Justin Pierel**, Steve Rodney (USC),
Pete Challis (CfA), Ken Chambers, Mark Huber (IfA), Tony Piro, Barry Madore (Carnegie)



Current Systematic Uncertainty Budget



Jones et al. 2019

Pan-STARRS Survey

1.8 m mirror

7 deg² Field of View

1.4 Gigapixel Camera

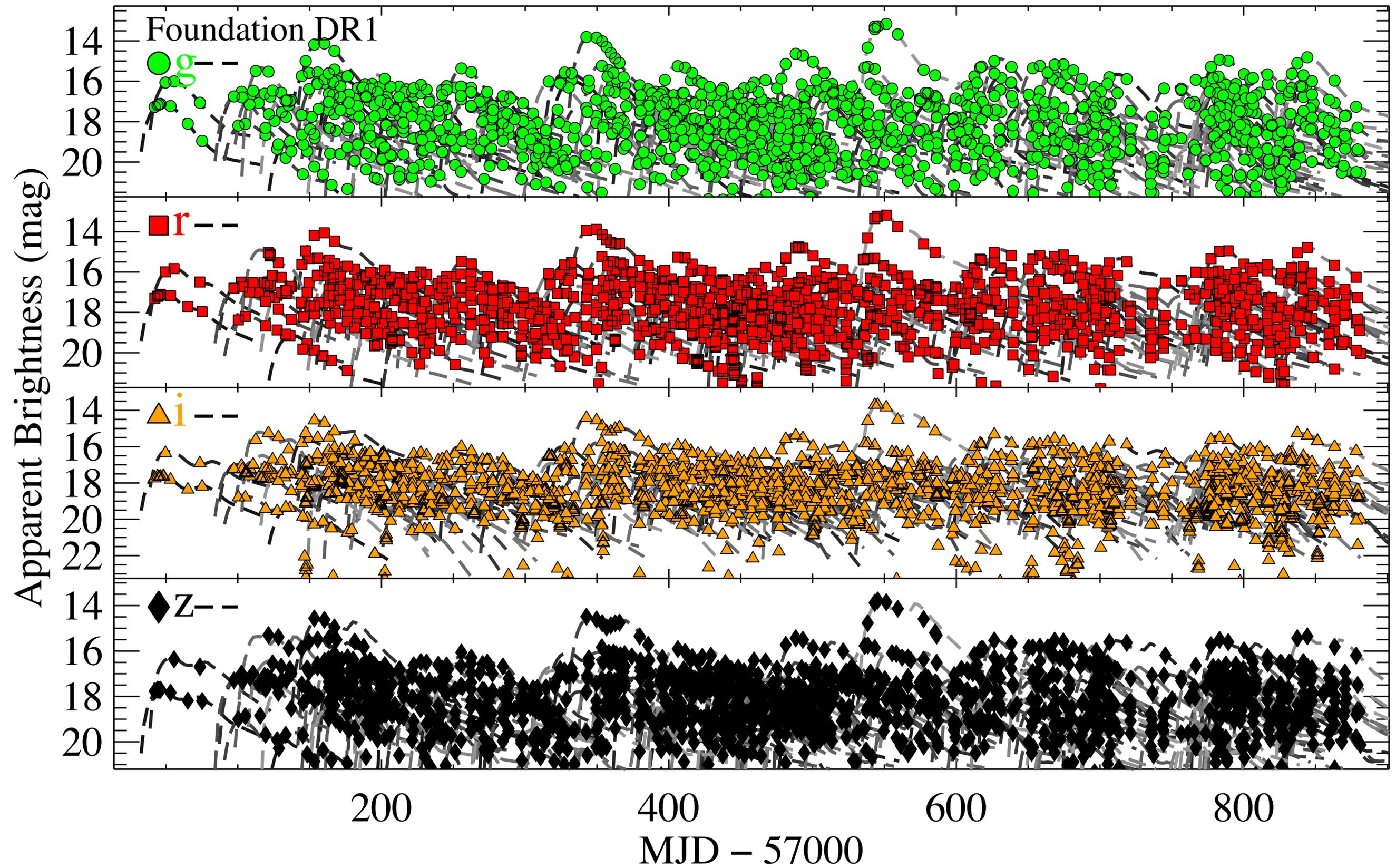
Ran from 2009 – 2013

Covers All Sky $> -30^\circ$

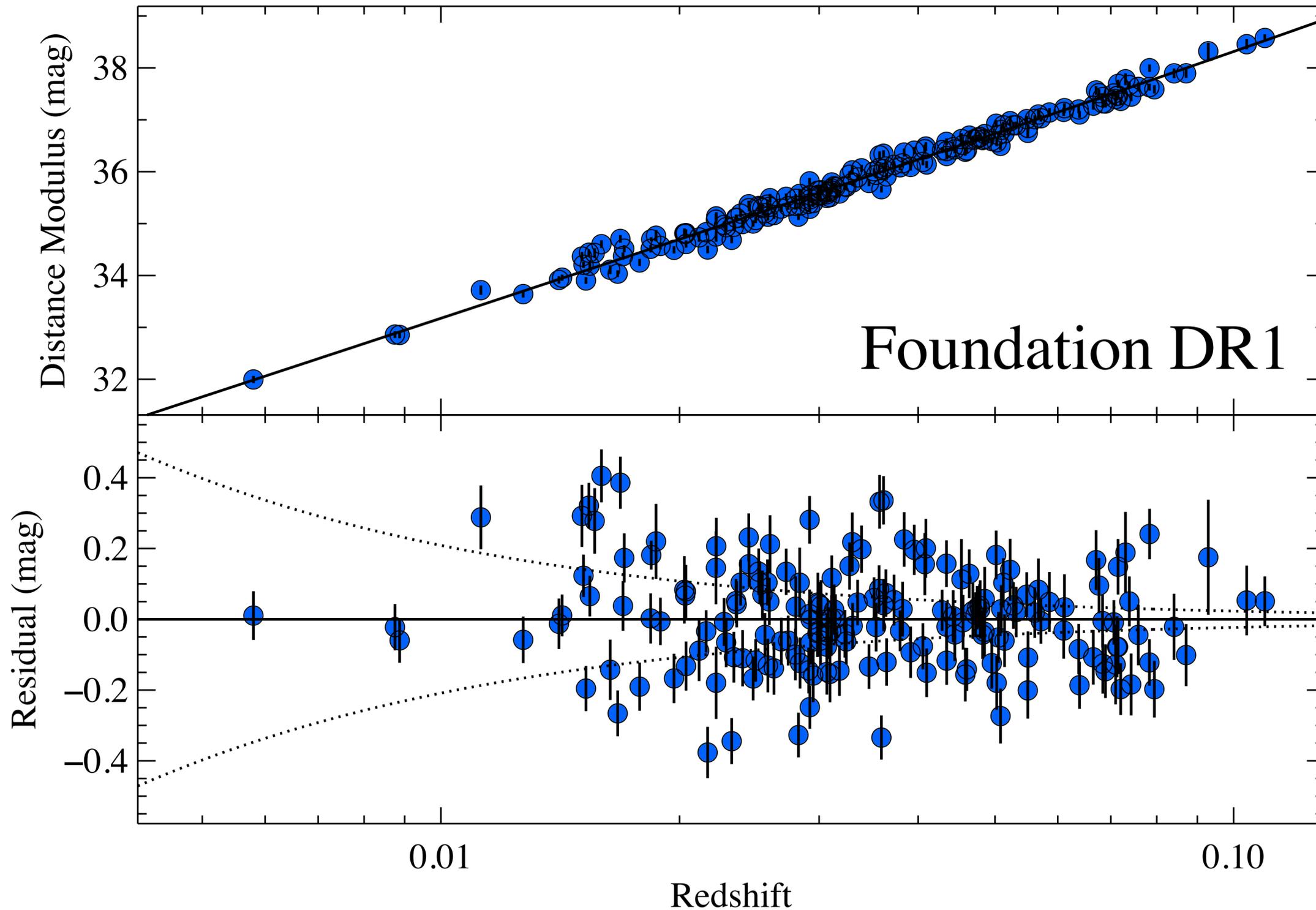
**grizy photometry over 3π as
deep or deeper than SDSS
(with better seeing)**

**Best ground-based
calibration**

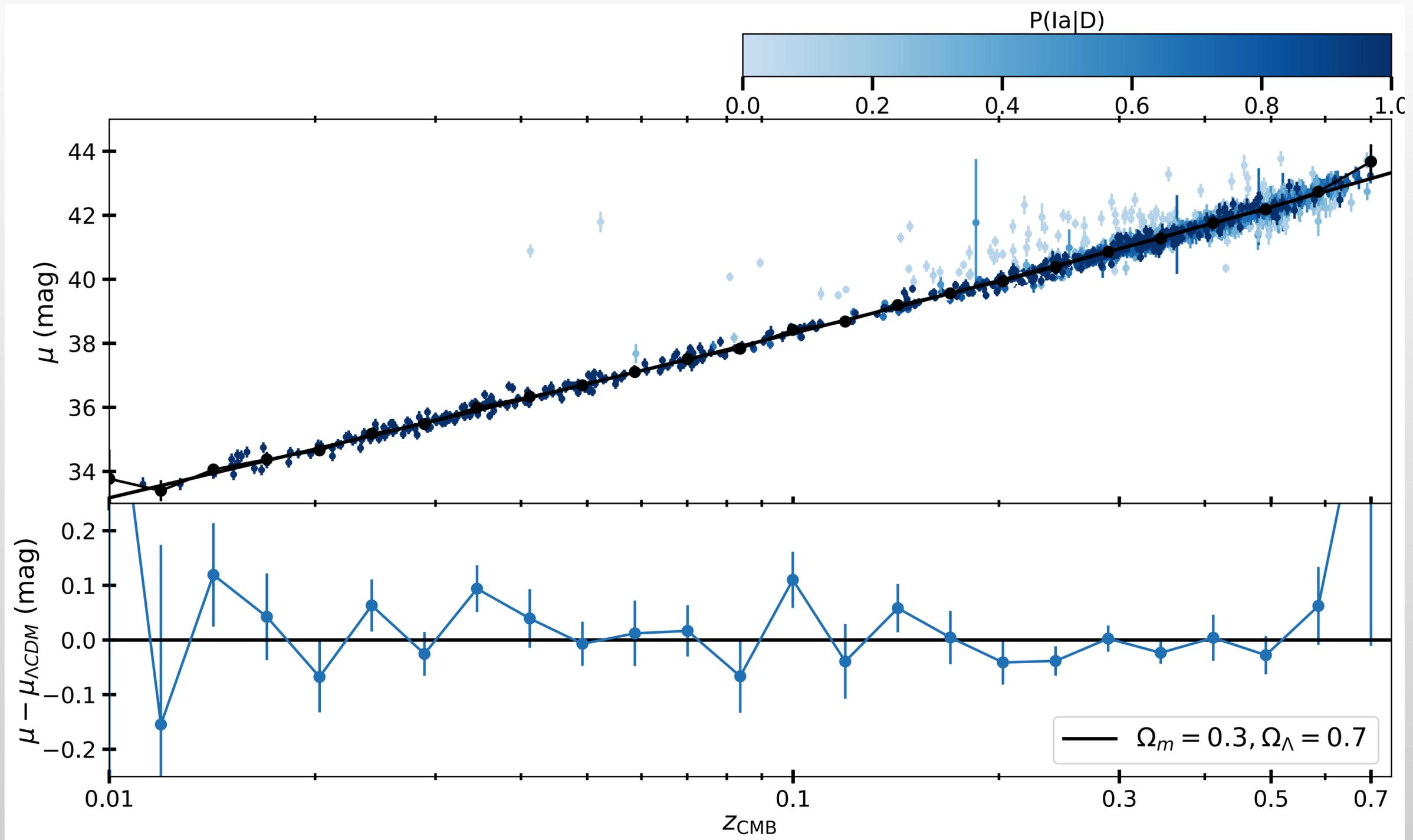




Foundation DR1: 185 Good SNe Ia



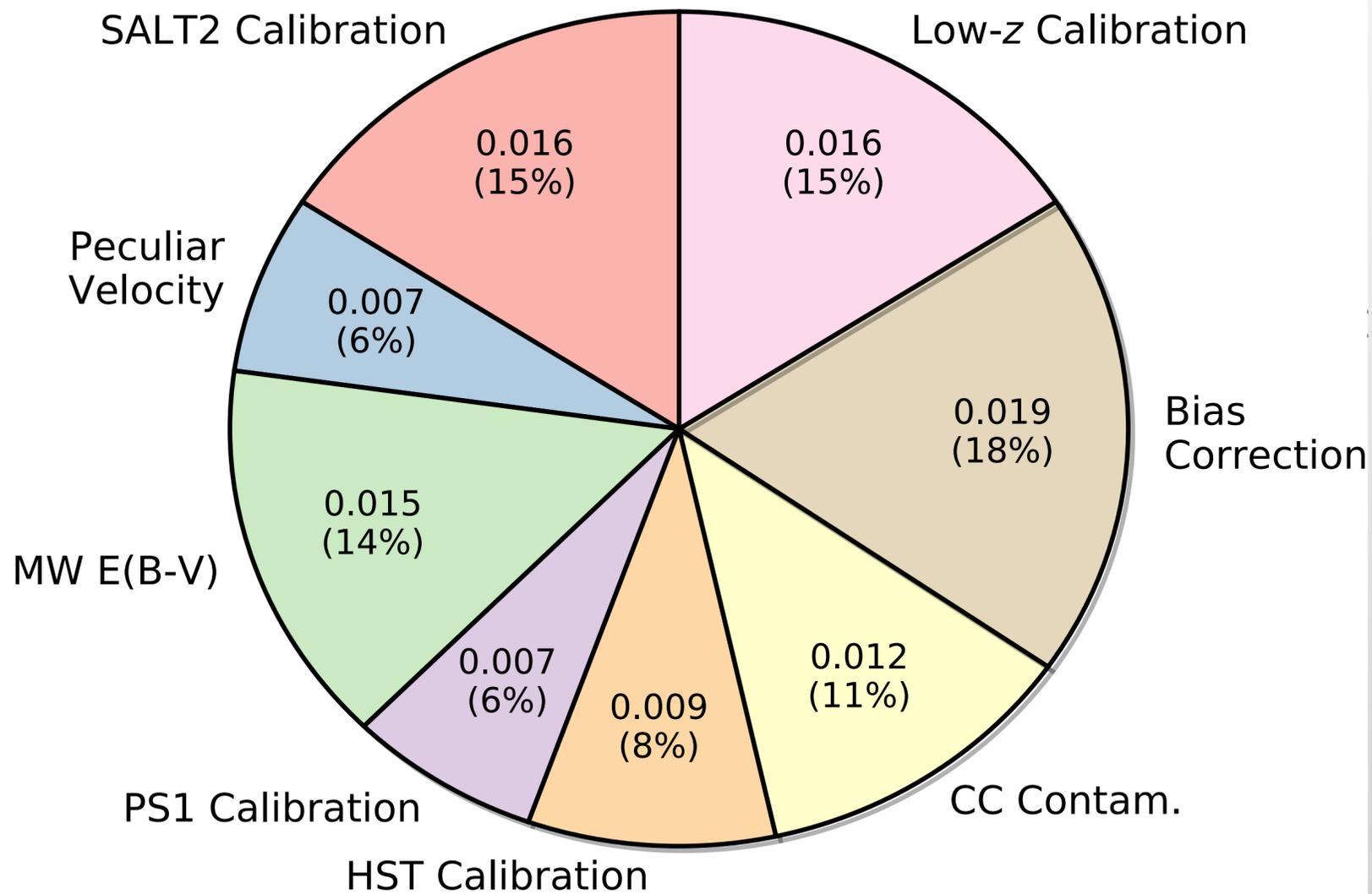
Cosmology with a Single Telescope



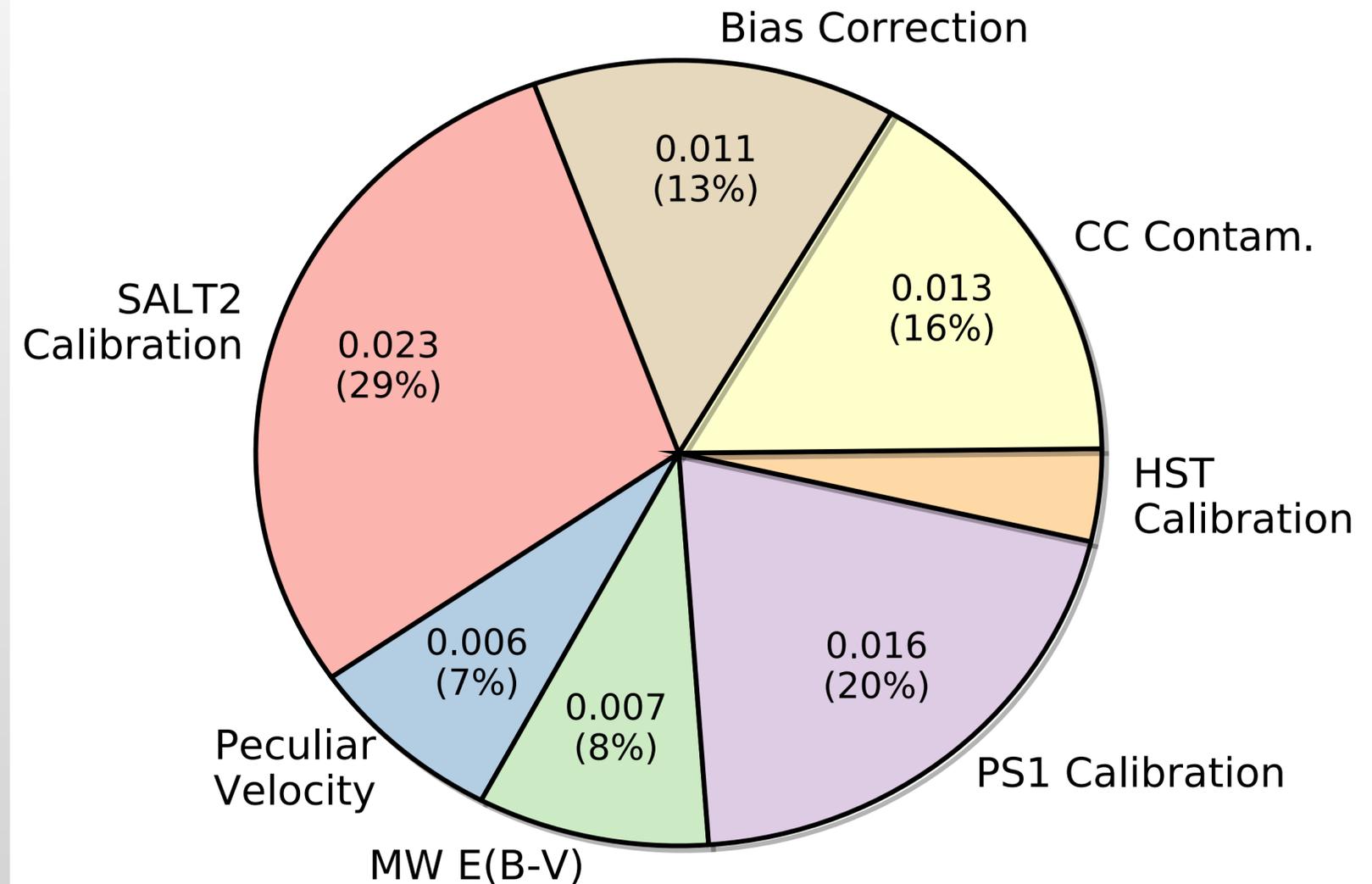
Jones et al. 2019

Updated Systematic Uncertainty Budget

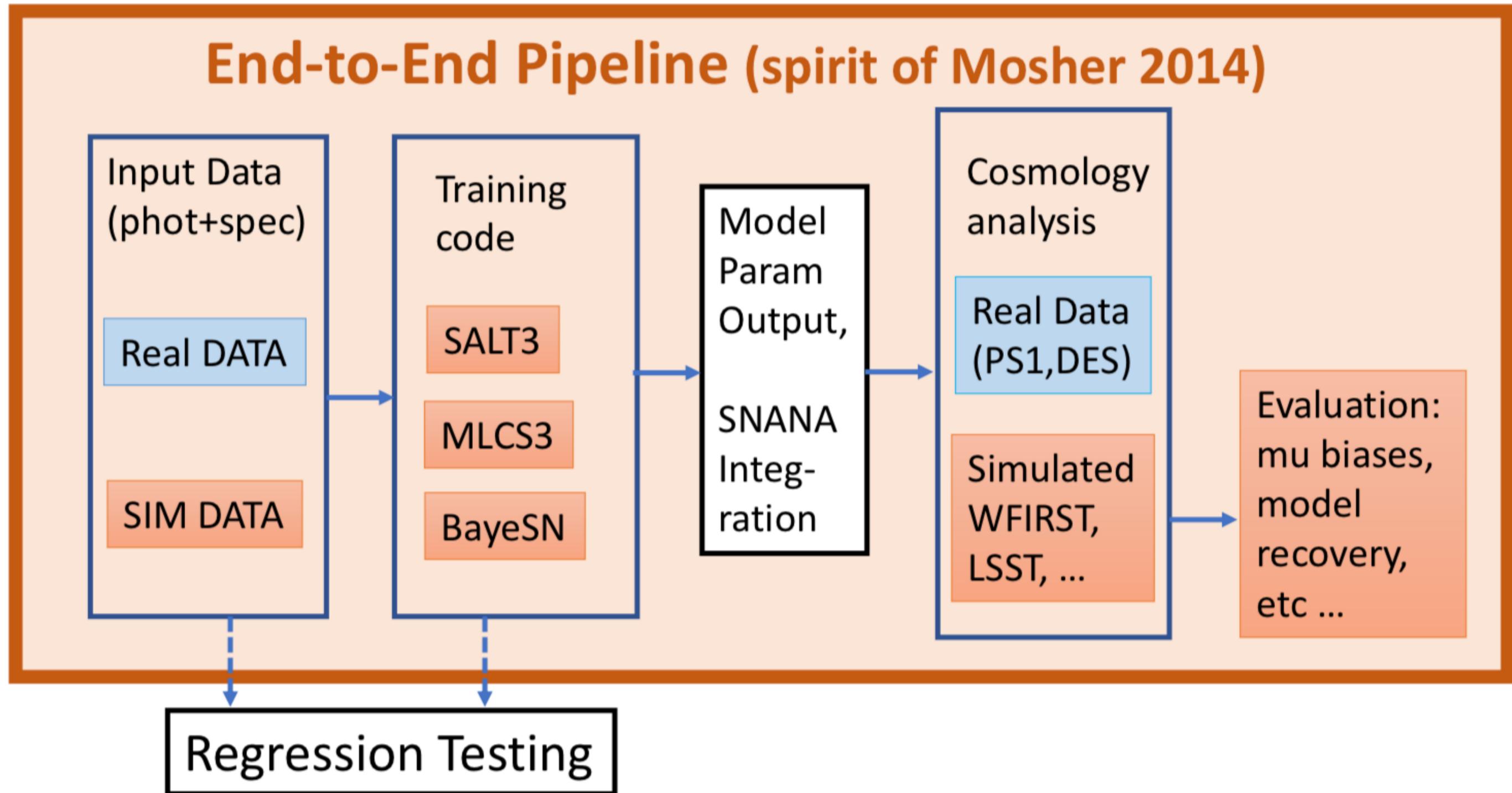
Systematic Uncertainties on w
from MDS+Previous Low-z SNe ($\sigma_{\text{sys}} = 0.043$)



Systematic Uncertainties on w
from MDS+Foundation SNe ($\sigma_{\text{sys}} = 0.039$)



Producing a New (NIR) SN Model



Swope Supernova Survey



Collaboration with Carnegie

~200 dark nights per year

Best calibrated Southern telescope for SN science

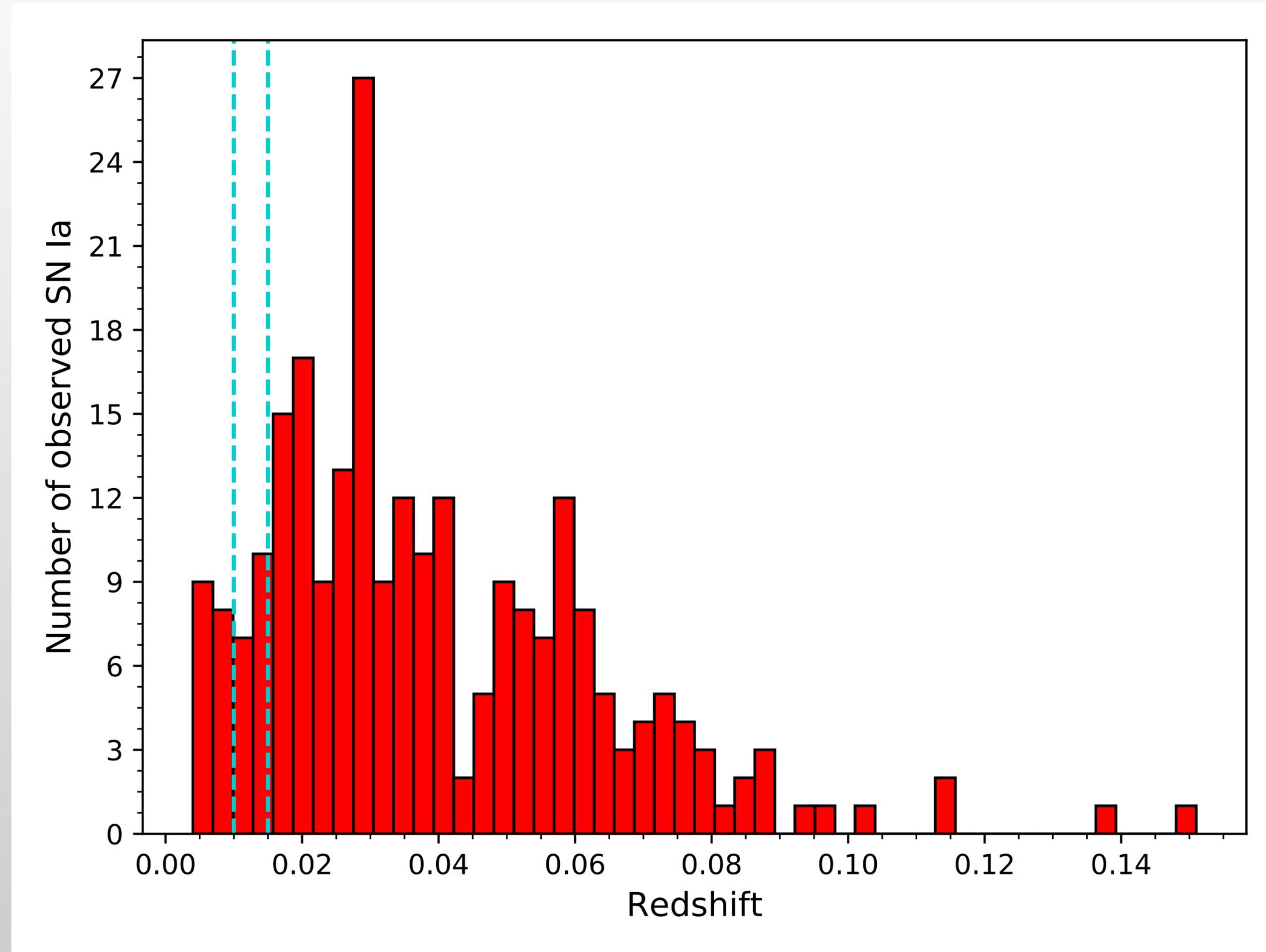
Additional 100+ SNe per year

High-cadence uBVgri light curves

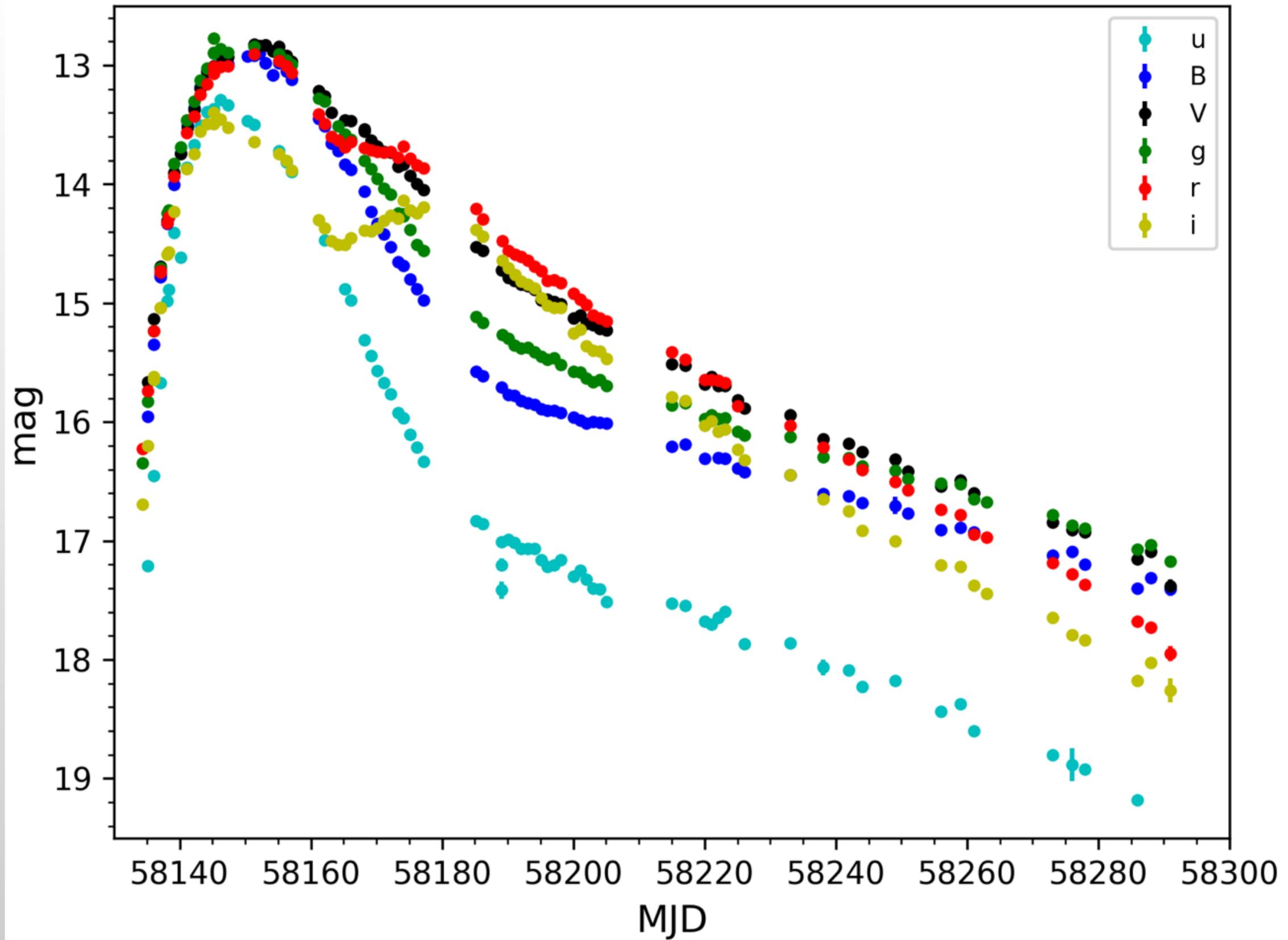
More Cepheid calibrators

Better calibration of ~300 CSP SNe

SSS DR1: 120 SNe Ia (270 observed)

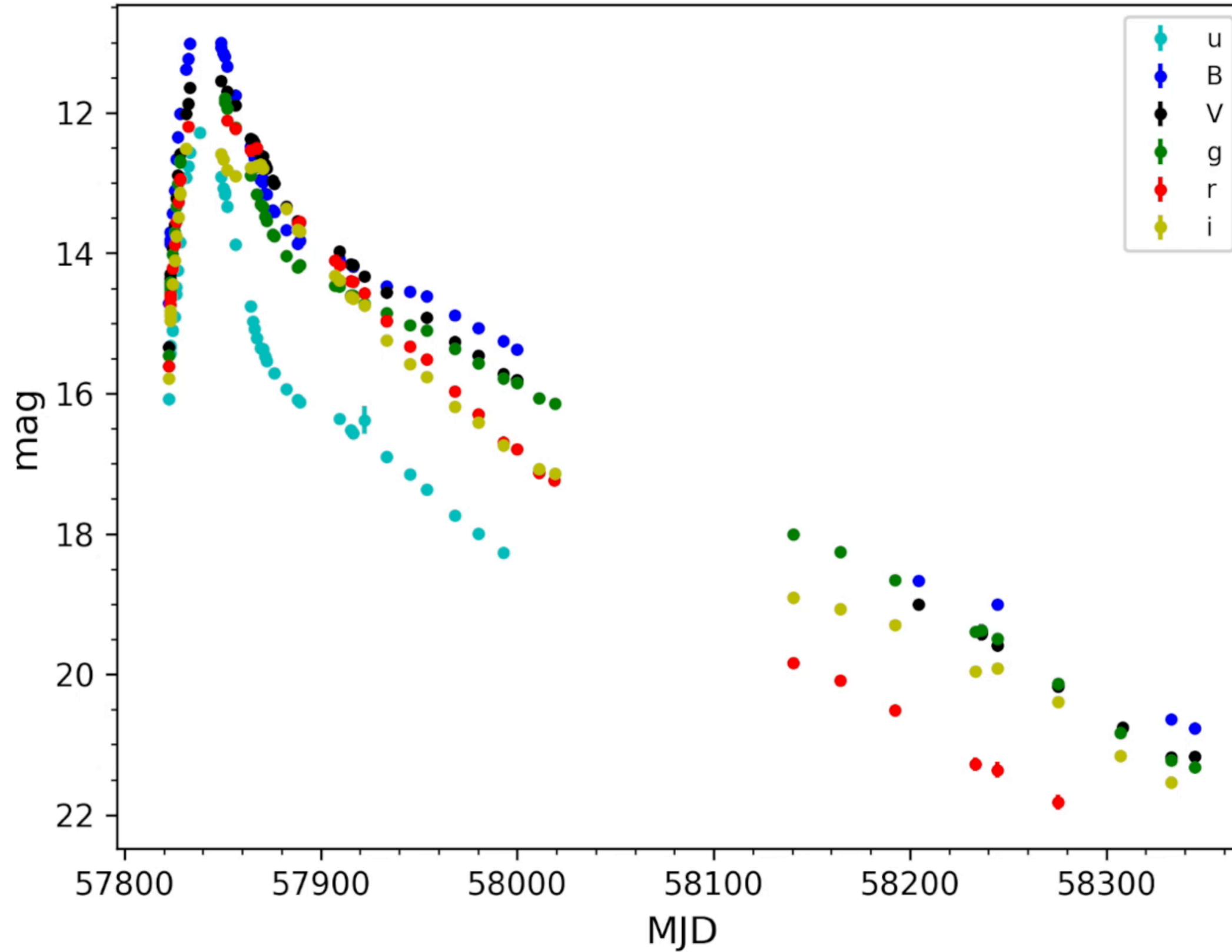


Rojas-Bravo et al. 2020 (submitted soon)

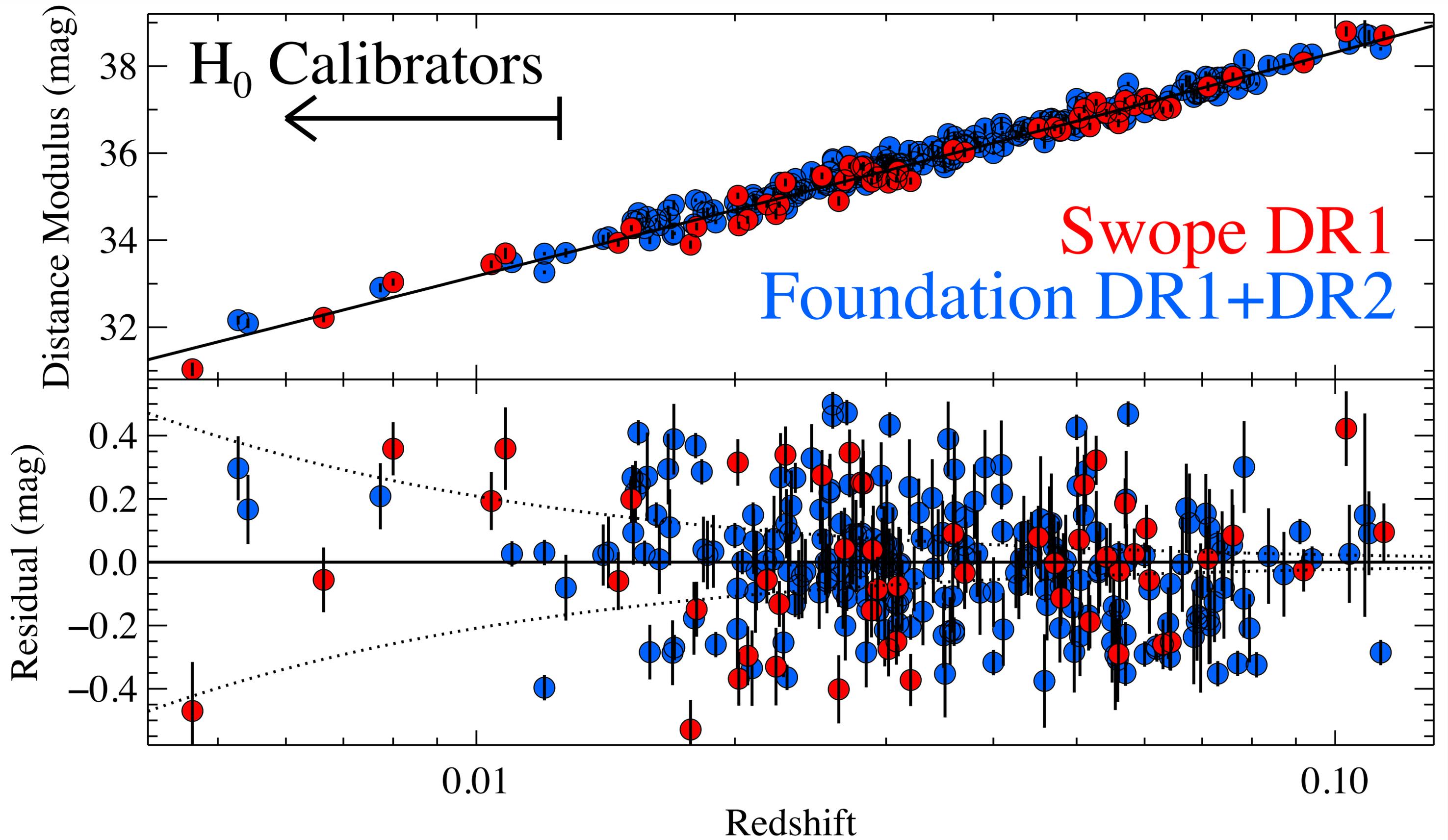


Rojas-Bravo et al. 2020

2017cbv, z=0.003999



Rojas-Bravo et al. 2020





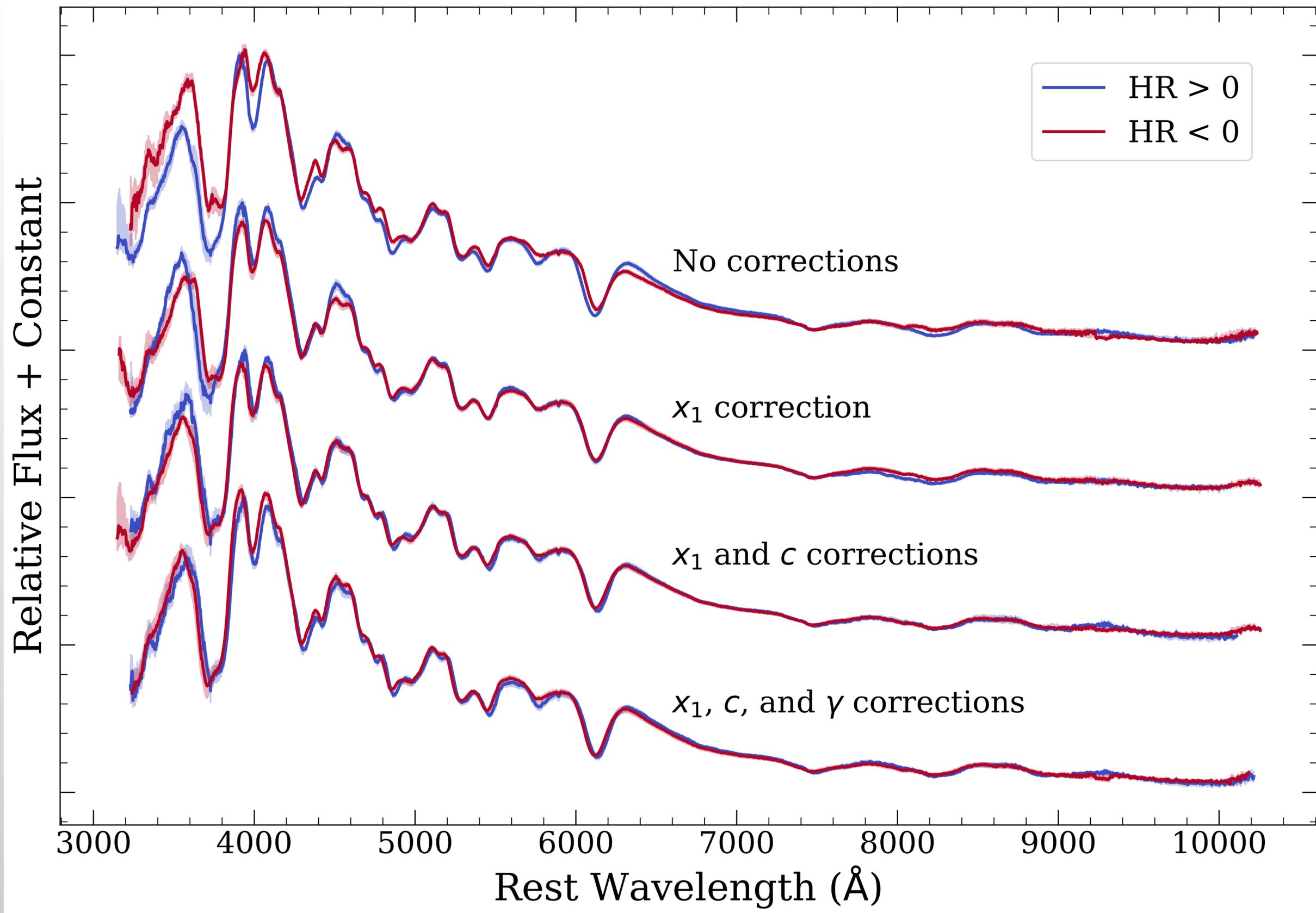
5000 spectra

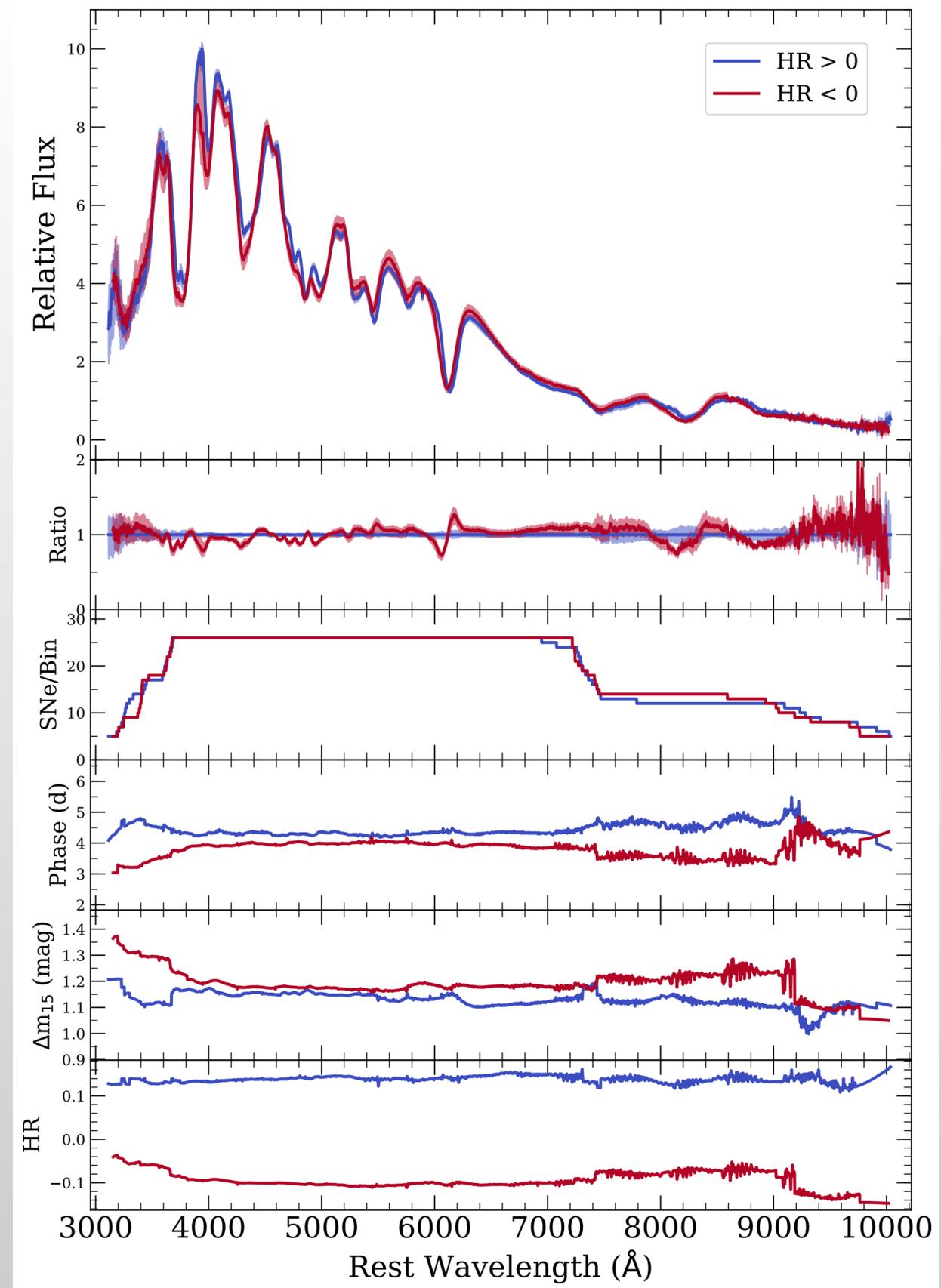
Siebert et al. 2019a

800 SNe Ia

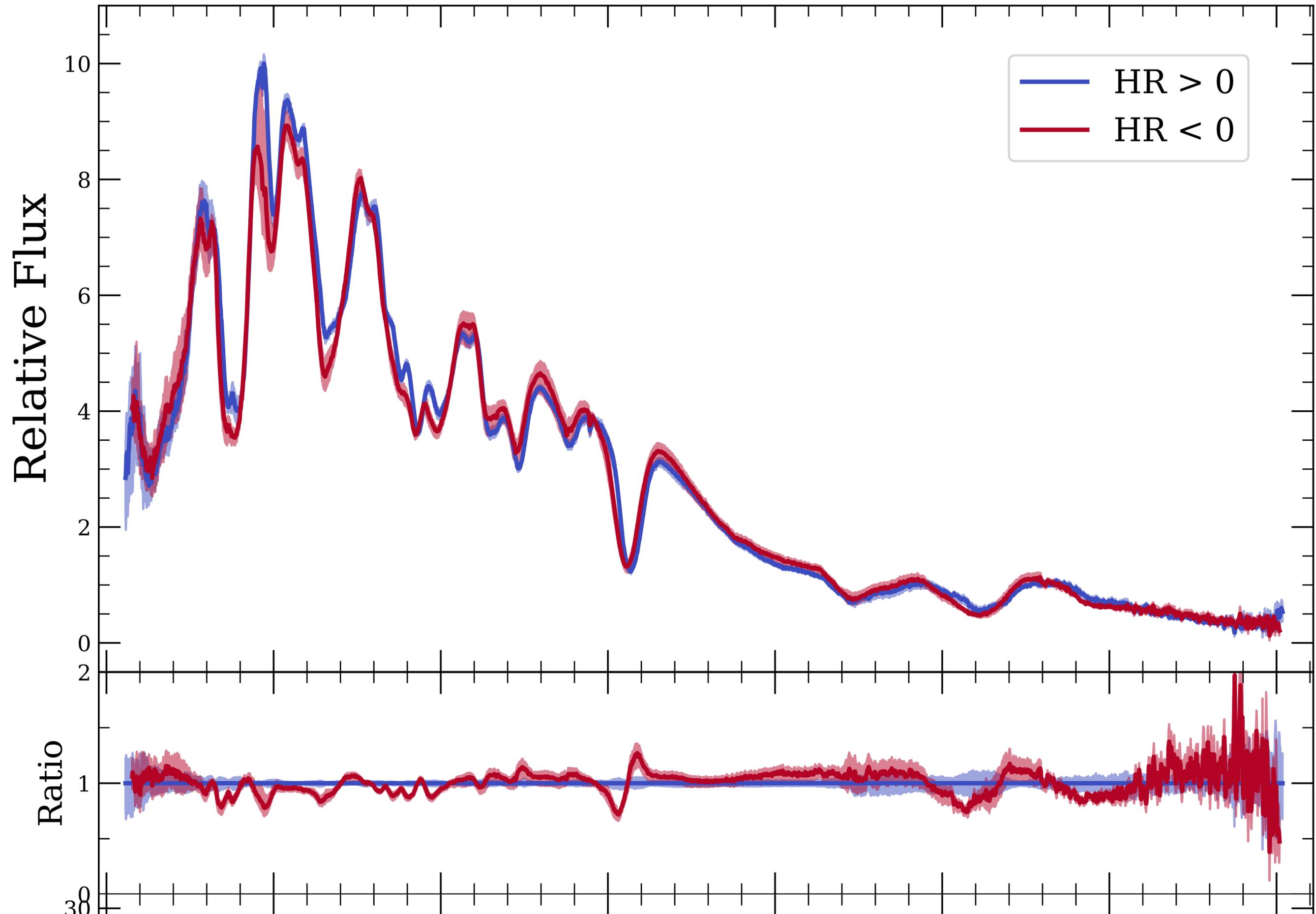
56 categories of metadata

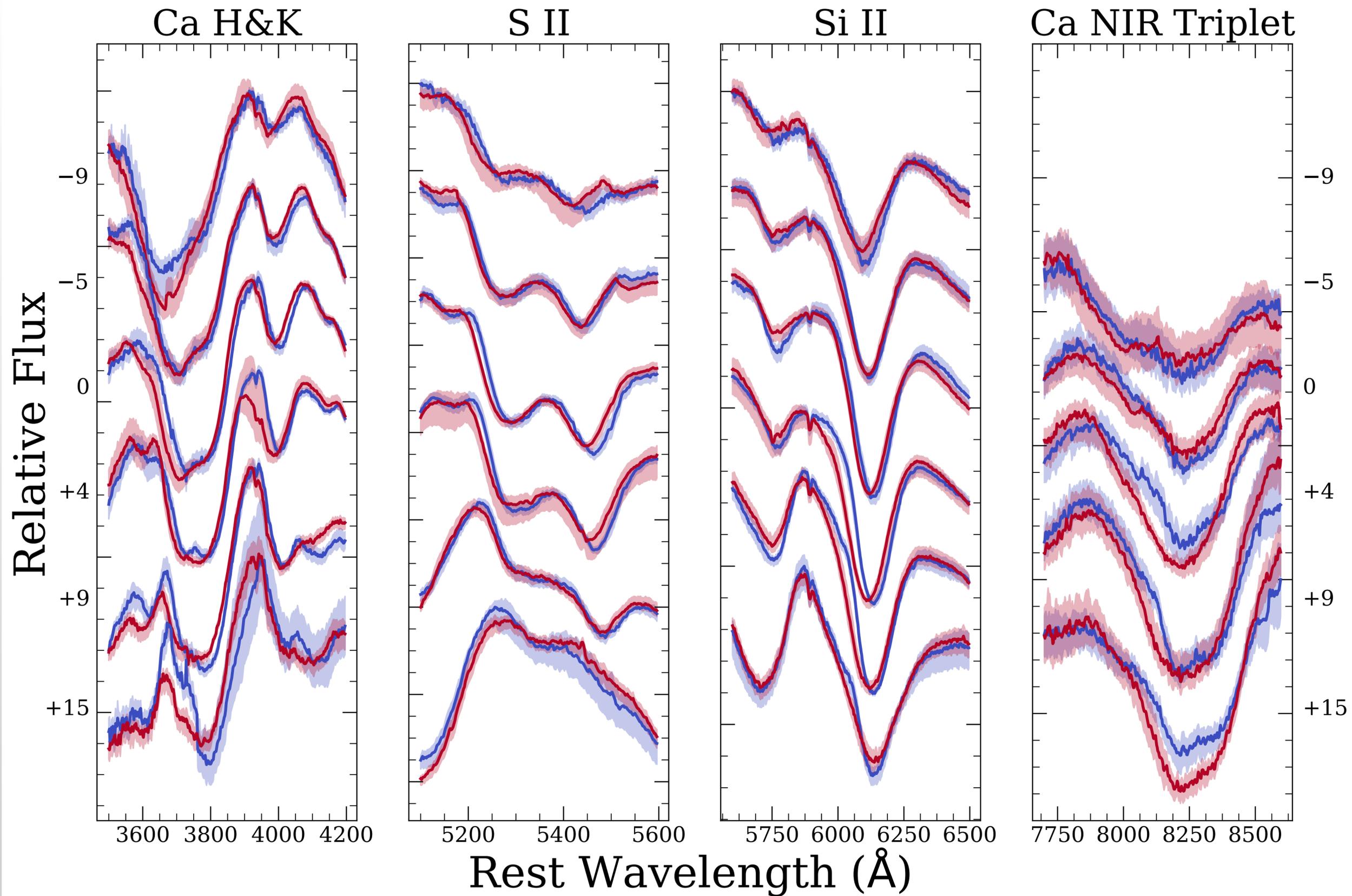
<https://kaepora.readthedocs.io/>

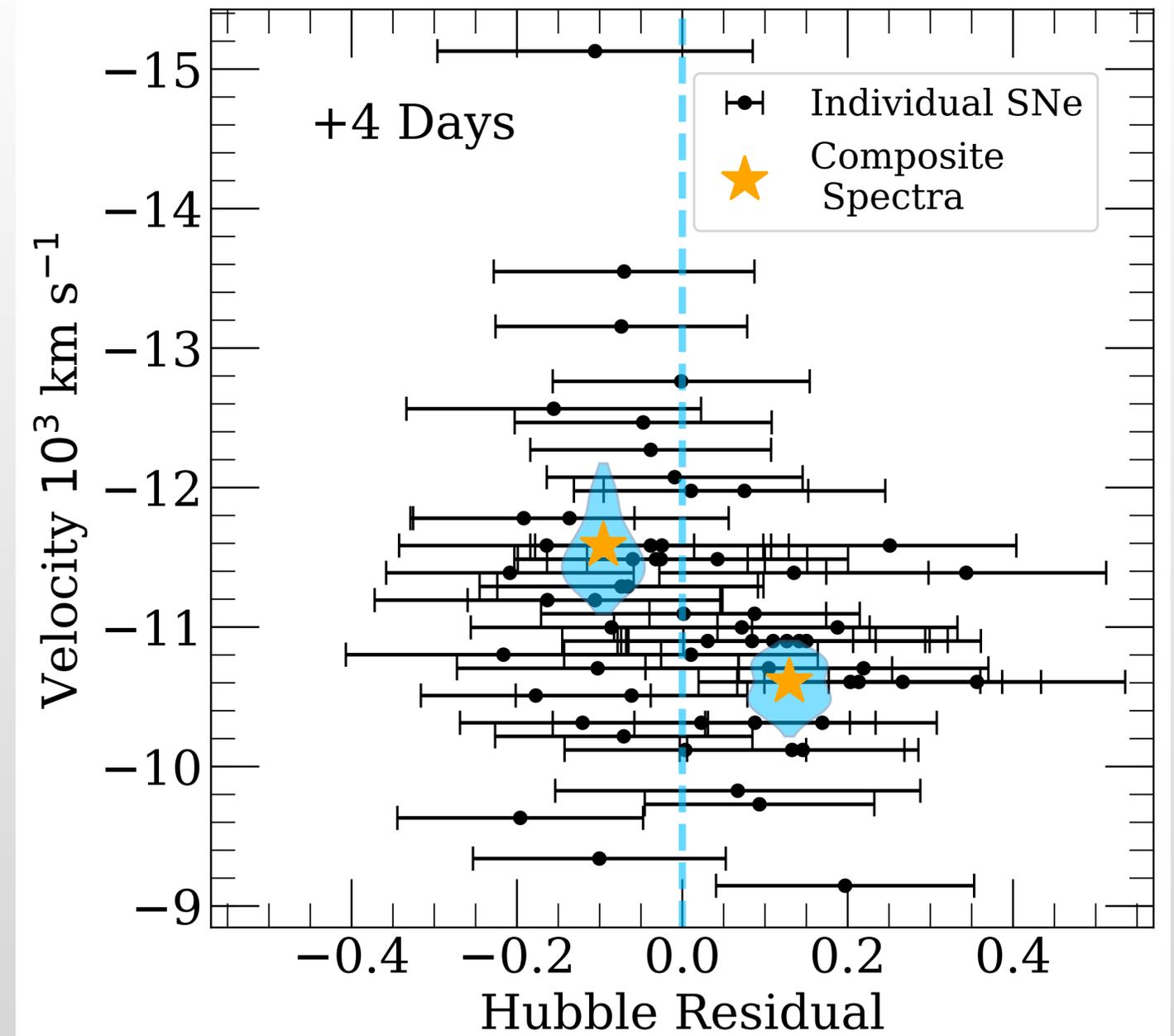
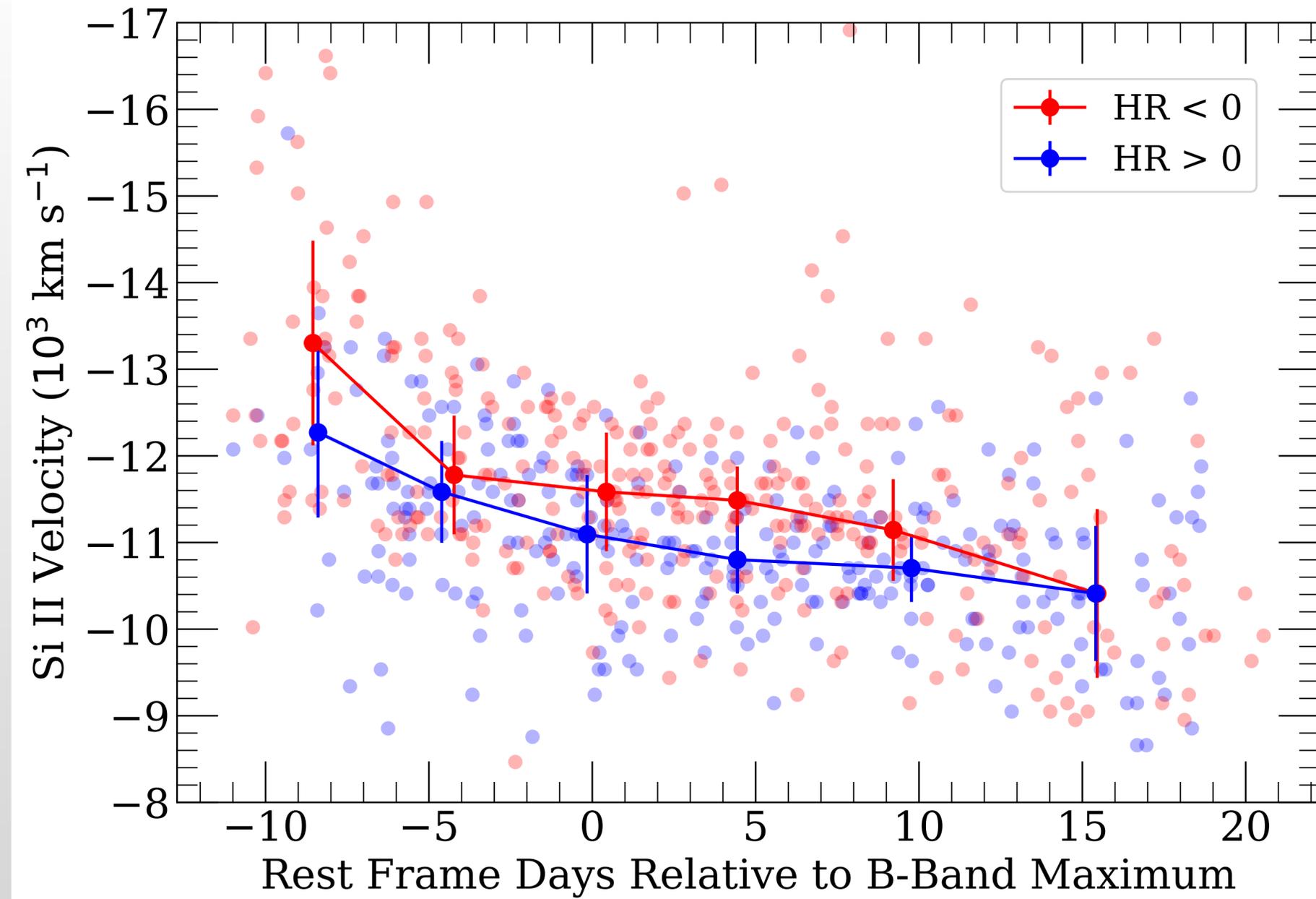




Siebert et al. 2019b

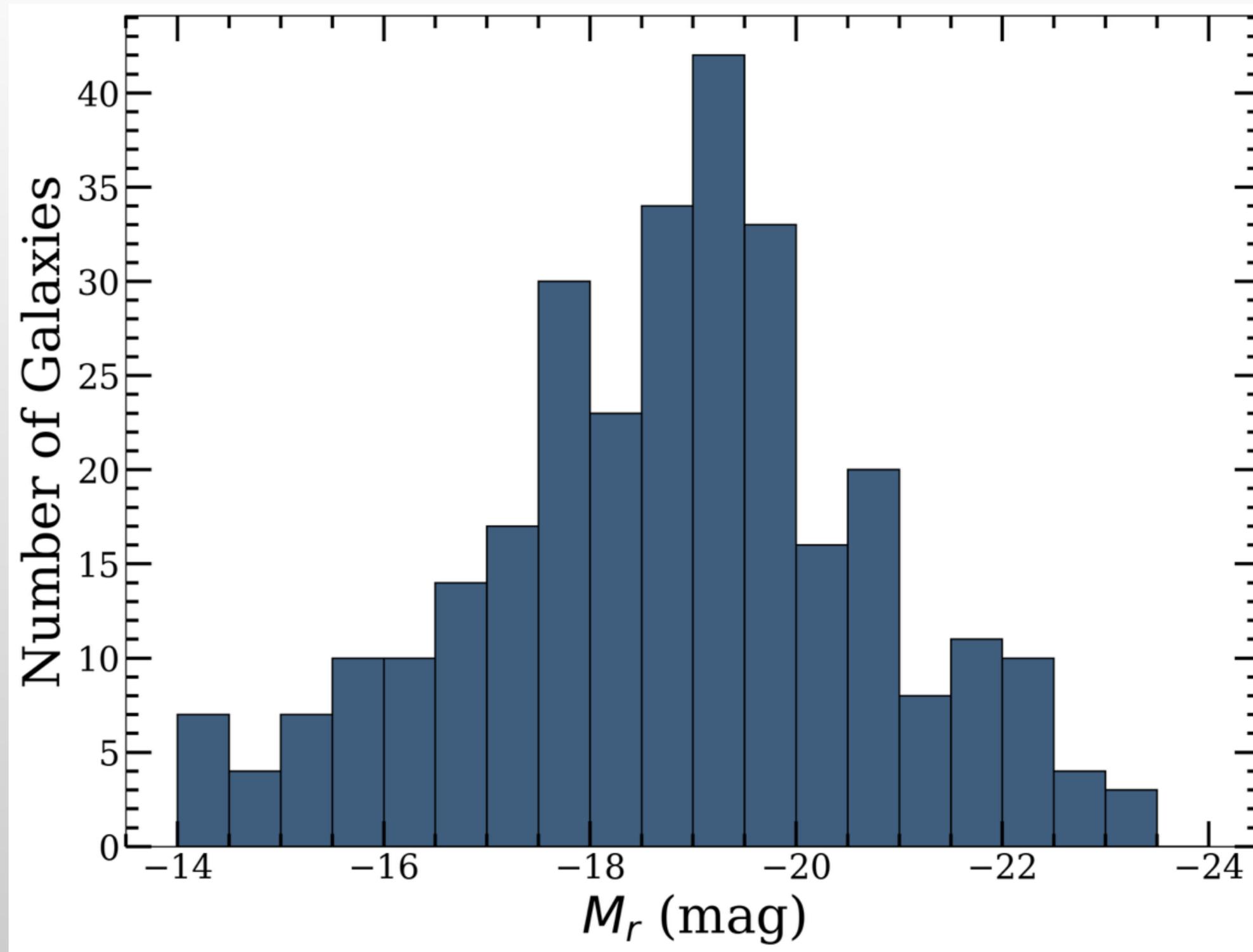






Siebert et al. 2019b

Several Very Low-Luminosity Host Galaxies



Siebert et al. 2020

Conclusions

- **Foundation and Swope Have Observed >500 low-z SNe Ia**
- **O(10) New Calibrators for H_0 .**
- **Significant Improvement in Calibration and Reduction of Systematics**
- **Training Sample for Next-Generation Light-Curve Fitting**
- **Kaepora is Extremely Powerful for Detailed Analyses**
- **SNe Ia with Negative HRs have Higher Velocity**
- **Hiring postdocs for next year**