Updates to the Union SNe Ia Compilation

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Supernova Cosmology Project

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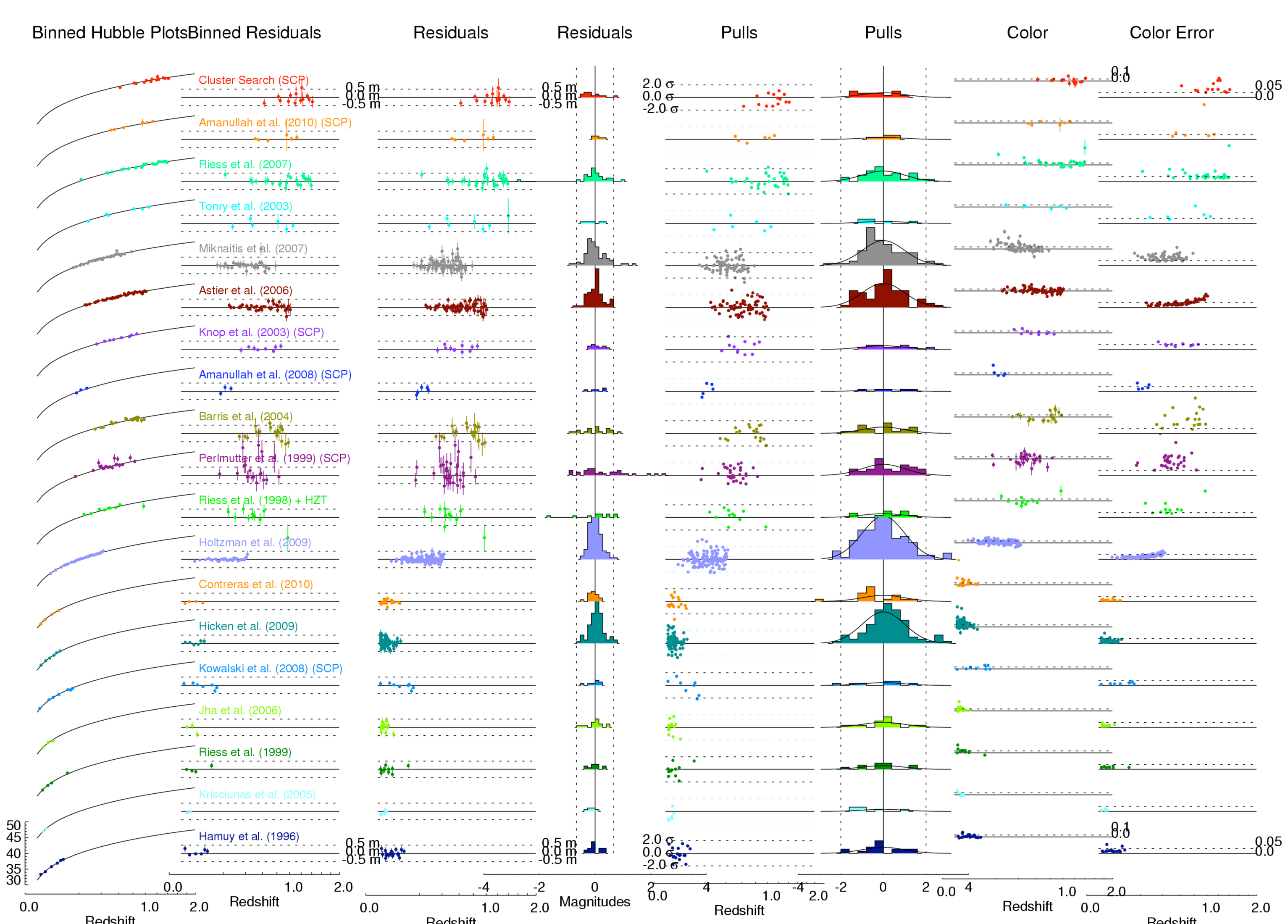
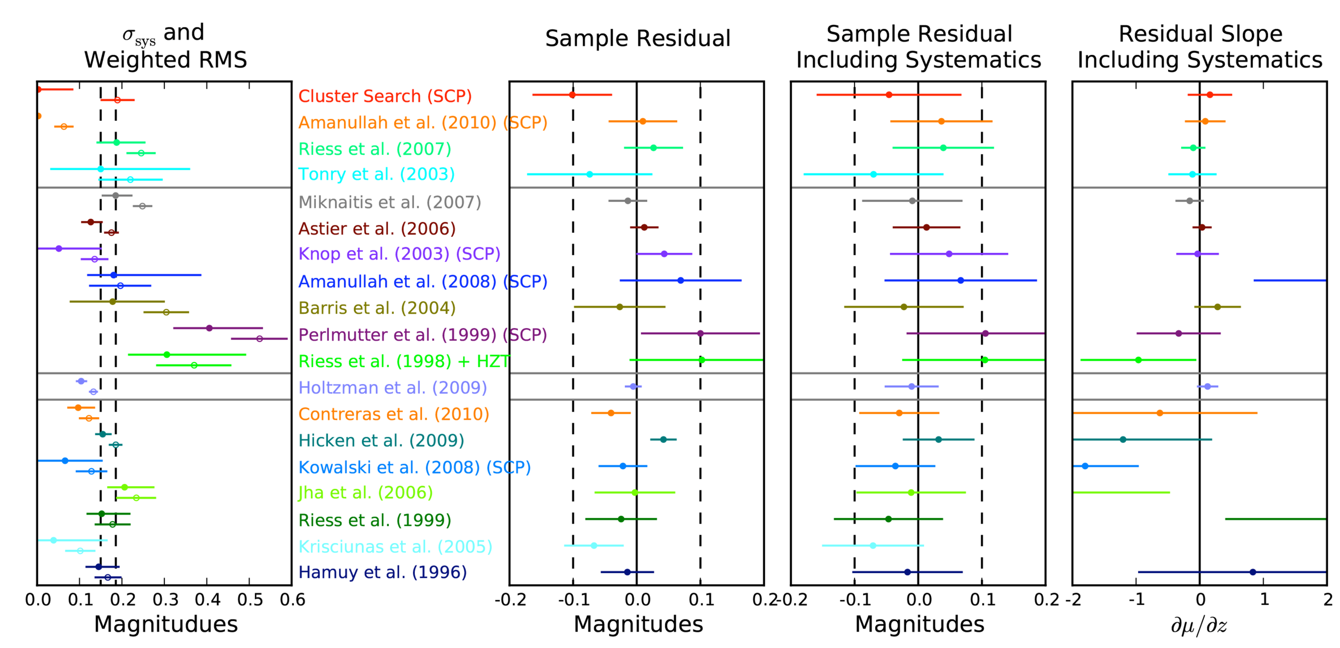
In a series of papers (Kowalski (ApJ, 2008), Amanullah (ApJ, 2010)) we have developed techniques to combine multiple datasets, search for tensions between datasets, quantify systematic errors, and to propagate this understanding into the cosmology fits. These analyses were developed with the cosmology hidden, potentially reducing bias. Here, we present refinements to our analysis, and the addition of new supernovae. We also discuss applications for high-redshift spectrophotometric surveys such as a WFIRST concept.

The latest Union compilation is always available as a list of supernova distances with a covariance matrix and a CosmoMC module at supernova.lbl.gov/Union

Union Analyses



This plot shows each dataset in the Union analysis in detail.



This diagnostics plot gives a summary of all of the datasets, showing a comparison of data quality and simple statistics of the Hubble residuals.

Analysis Updates

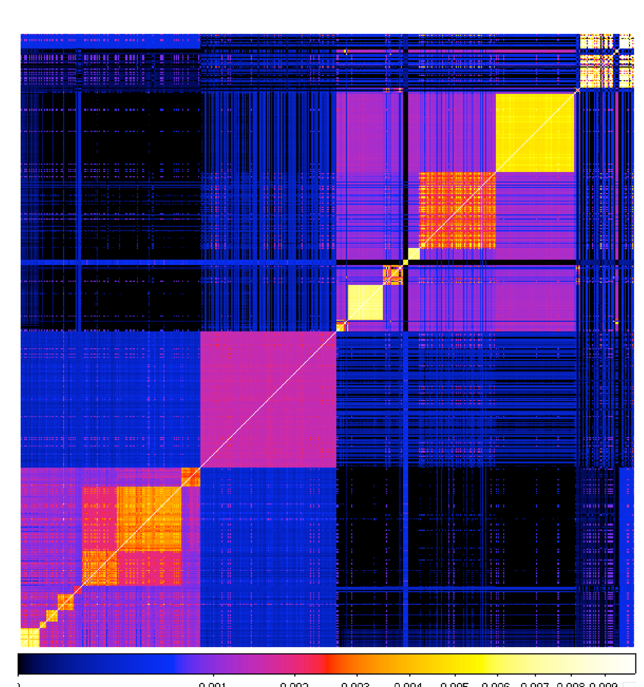
We correct each supernova for the correlation between host-mass and luminosity. As we do not have a host mass for each supernova, we must use a Bayesian method to make efficient use of the host mass measurements we have.

We also update the HST NICMOS F110W zeropoint and uncertainty (Ripoche et al., in prep), a crucial measurement for constraining the color of most z > 1 SNe.

Systematic Errors

Each Union analysis incorporates estimates of the systematic errors into a covariance matrix, used when computing cosmological constraints.

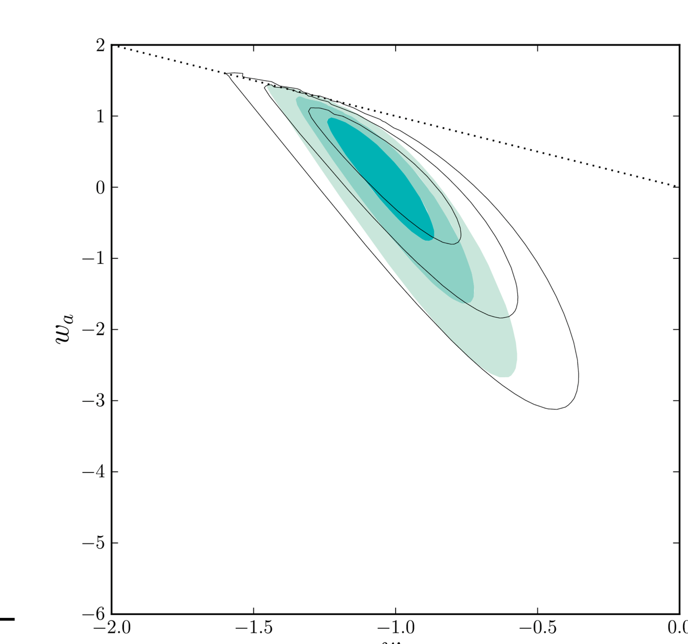
New systematic errors to this analysis include an uncertainty due to the host-mass luminosity correction, and potential uncertainties in the HST ACS filter responses.



covariance matrix, sorted by set

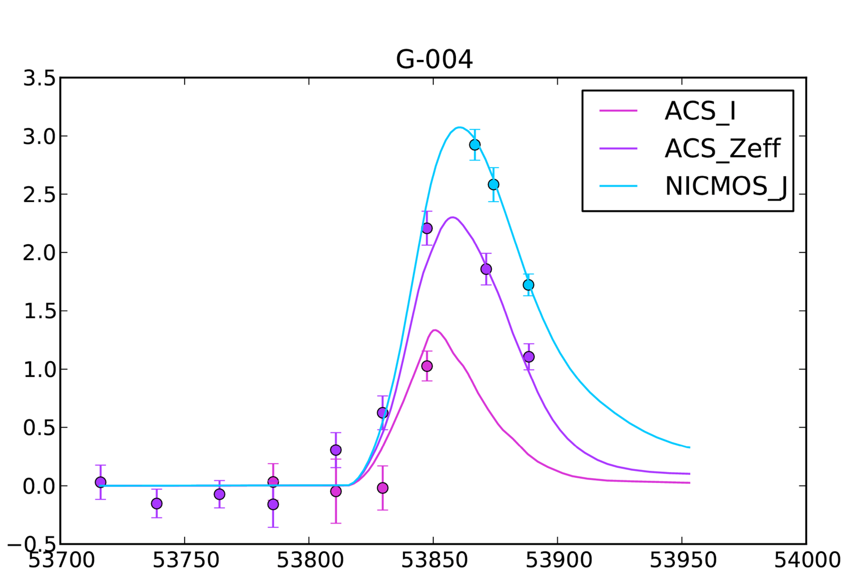
Source	Error on Constant w	Error on w_a
Vega	0.039	0.27
Zeropoints	0.036	0.25
–ACS Zeropoints	0.005	0.08
–ACS Filter Shift	0.009	0.11
–NICMOS Zeropoints	0.009	0.10
Malmquist Bias	0.023	0.16
Color Correction	0.023	0.16
Mass Correction	0.022	0.27
Contamination	0.018	0.13
Intergalactic Extinction	0.015	0.04
Galactic Extinction Normalization	0.012	0.03
Rest-Frame U-Band Calibration	0.009	$\lesssim 0.03$
Lightcurve Shape	0.006	0.06
Quadrature Sum (not used)	*0.072*	*0.53*
Summed in Covariance Matrix	0.064	0.38

effect of each systematic error



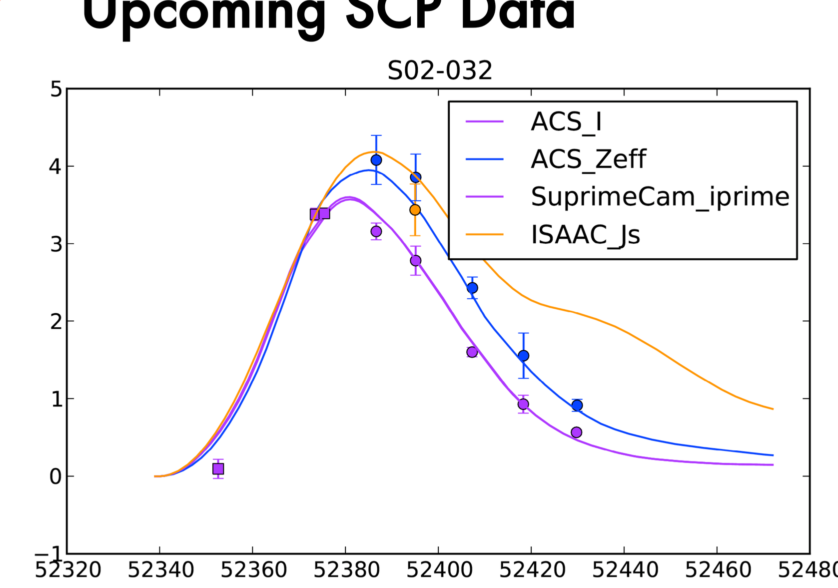
constraints on w_0-w_a with and without supernova systematics

SCP Supernovae Added



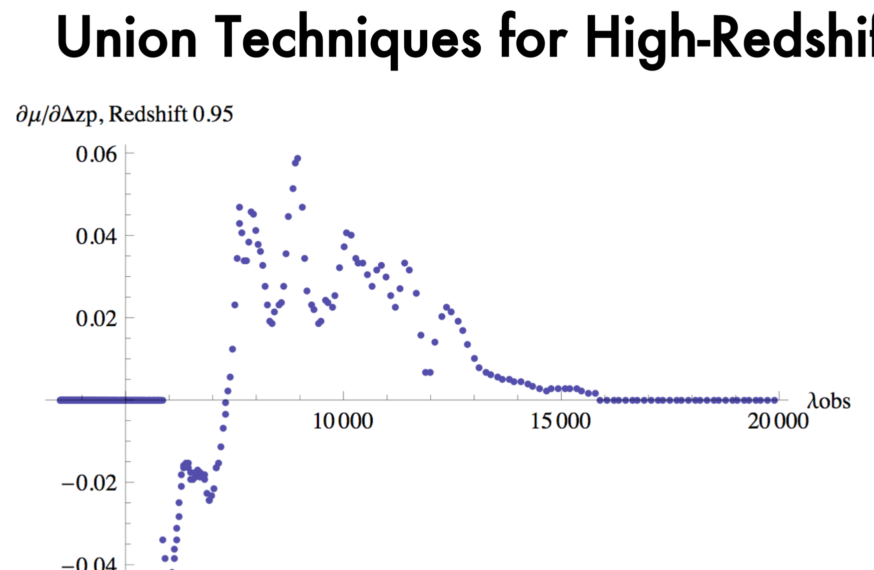
We have incorporated the HST Cluster Search supernovae (see the poster by Suzuki et al. 249.09) into the Union compilation, as well as CSP supernovae. The Cluster Search Supernovae at z > 1 have a combined weight of 70% the z > 1 GOODS SNe, despite using 1/3 the orbits. This updated version of Union will be available soon.

Upcoming SCP Data

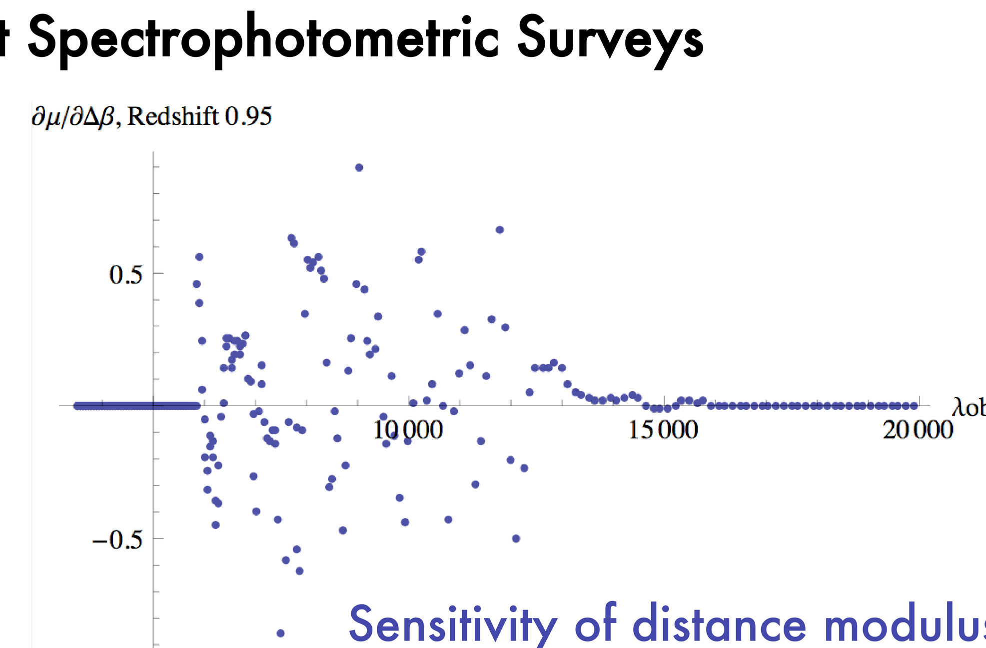


The Union compilation will next be updated with more high-redshift supernovae observed with a combination of HST, Subaru, and VLT. Combined, the z > 1 supernovae have a weight comparable to the HST Cluster Search.

Union Techniques for High-Redshift Spectrophotometric Surveys



Sensitivity of distance modulus to flux calibration



Sensitivity of distance modulus to wavelength (velocity) calibration

High-redshift spectrophotometric surveys may offer simpler calibration than a photometric survey, while yielding far more information on each supernova. The same methods of handling systematic errors for photometric data can also be used for spectroscopic data. Here, we illustrate the sensitivity of the distance modulus to flux and wavelength calibration. When combined with an estimate of calibration uncertainties, this can be propagated into a distance modulus covariance matrix.

Applications include informing calibration requirements, developing survey strategy, and allowing theorists to easily compute accurate projected cosmological constraints on their choice of model.

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