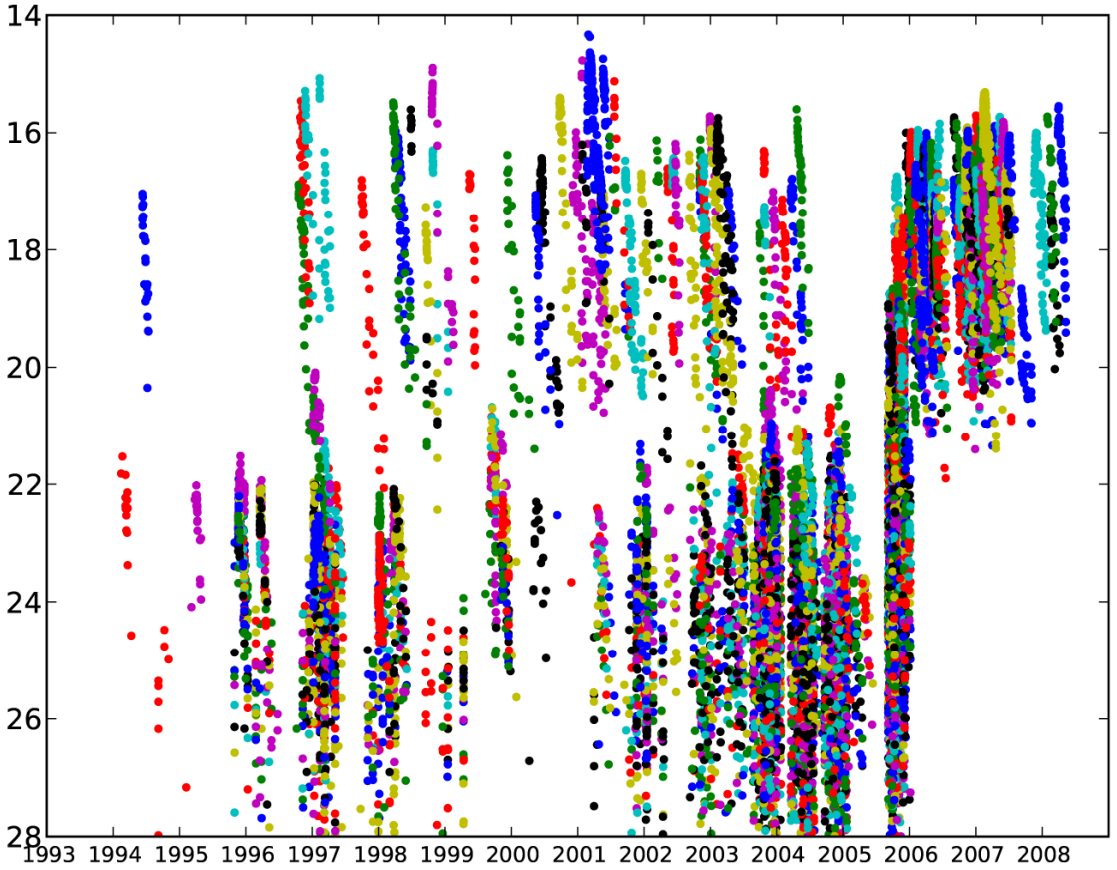
The SCP Union2 Compilation:

A Giant Step Towards Union3



David Rubin UC Berkeley & LBNL

Union++

We Added:

- CfA3, SDSS, and two SCP samples (Amanullah 2009 and 2010): 557 SNe total (250 more!)
- SALT2
- The handling of many systematics on a supernova-by-supernova basis, rather than binning

But It Still:

- Is a homogenous analysis, developed with the cosmology hidden
- Incorporates systematic errors in a covariance matrix
- Is available at supernova.lbl.gov/Union

2010ApJ...716..712A

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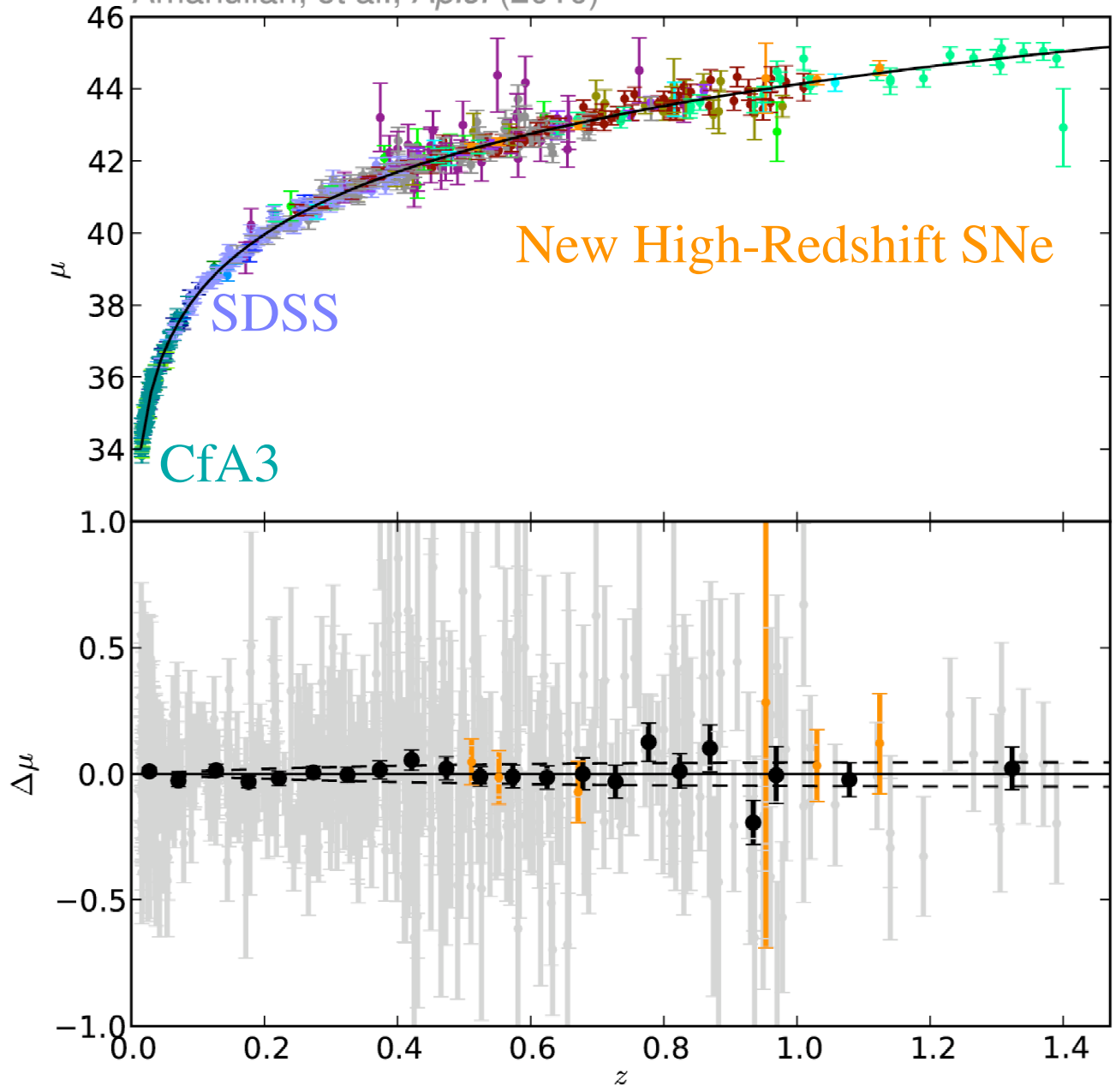
Supernova Cosmology Project
Amanullah, et al., *Ap.J.* (2010)



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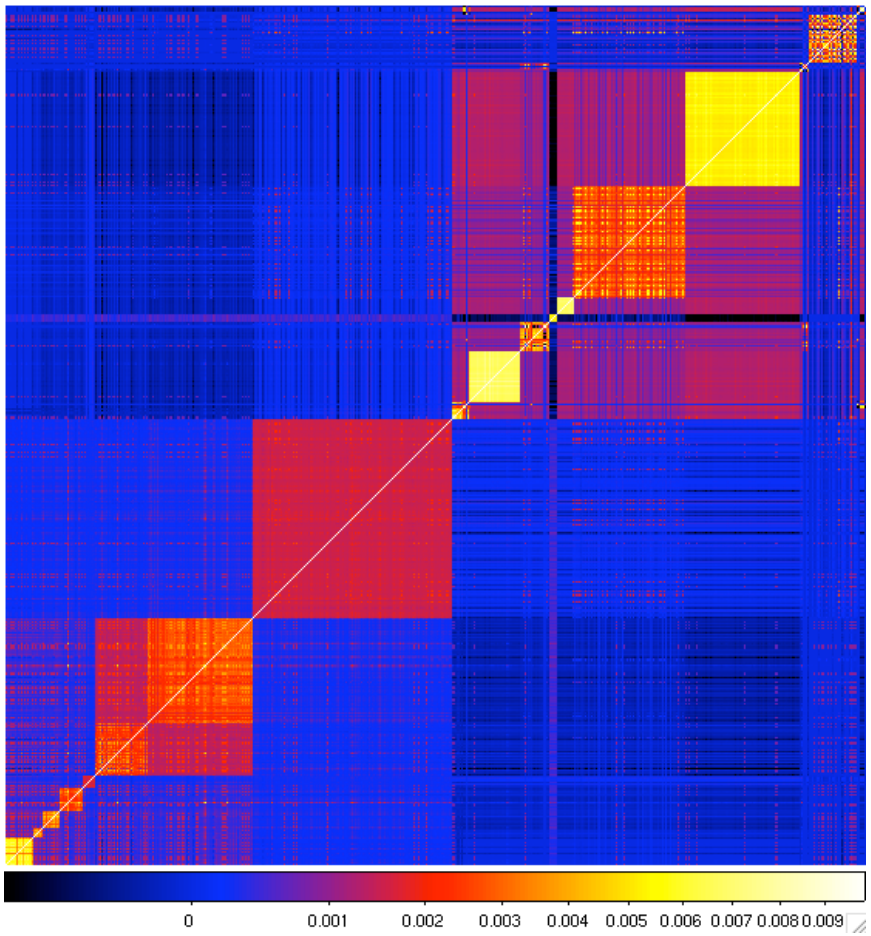
Treating the systematic errors as fit parameters and fitting them simultaneously with the Hubble diagram leads to:

$$V_{ij} = \sum_{\text{systematics}} \frac{\partial \mu_i}{\partial(\text{systematic})} \frac{\partial \mu_j}{\partial(\text{systematic})} d(\text{systematic})^2$$

Source	Error on w
Zero point	0.037
Vega	0.042
Galactic extinction normalization	0.012
Rest-frame U-band	0.010
Contamination	0.021
Malmquist bias	0.026
Intergalactic extinction	0.012
Light-curve shape	0.009
Color correction	0.026
Quadrature sum (not used)	0.073
Summed in covariance matrix	0.063

covariance matrix sorted by data-set



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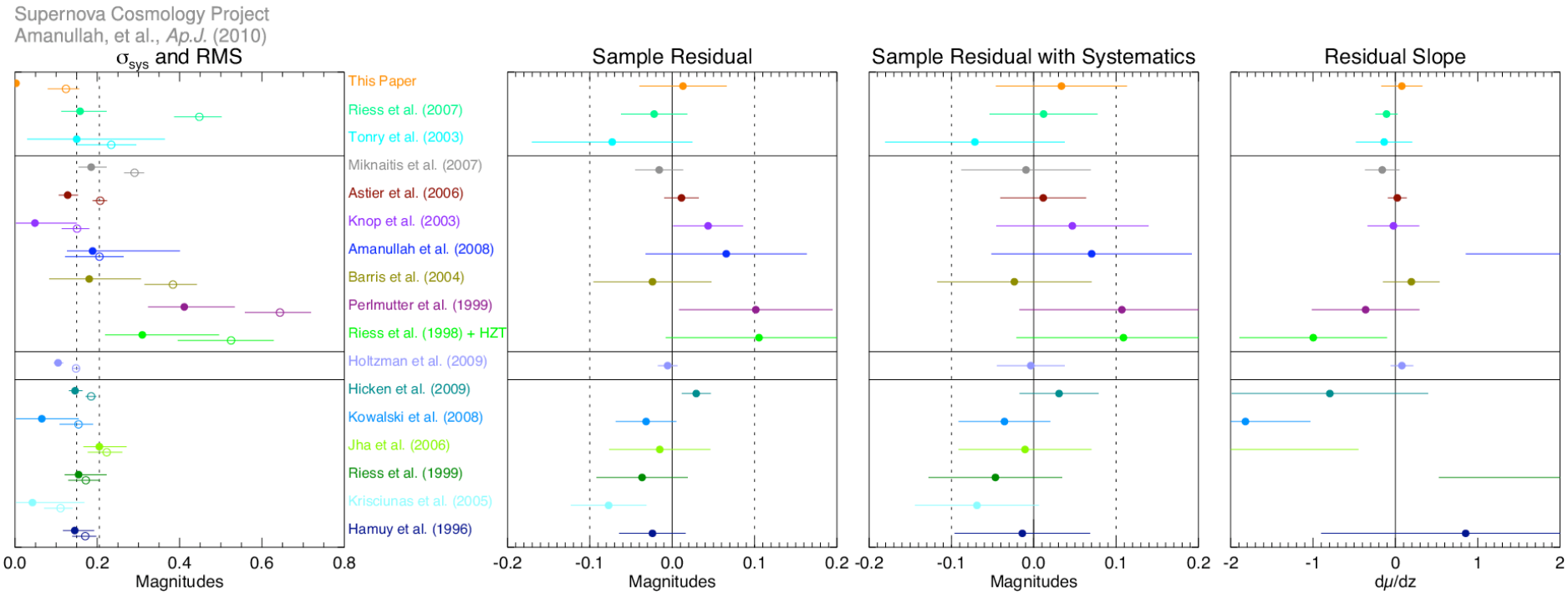
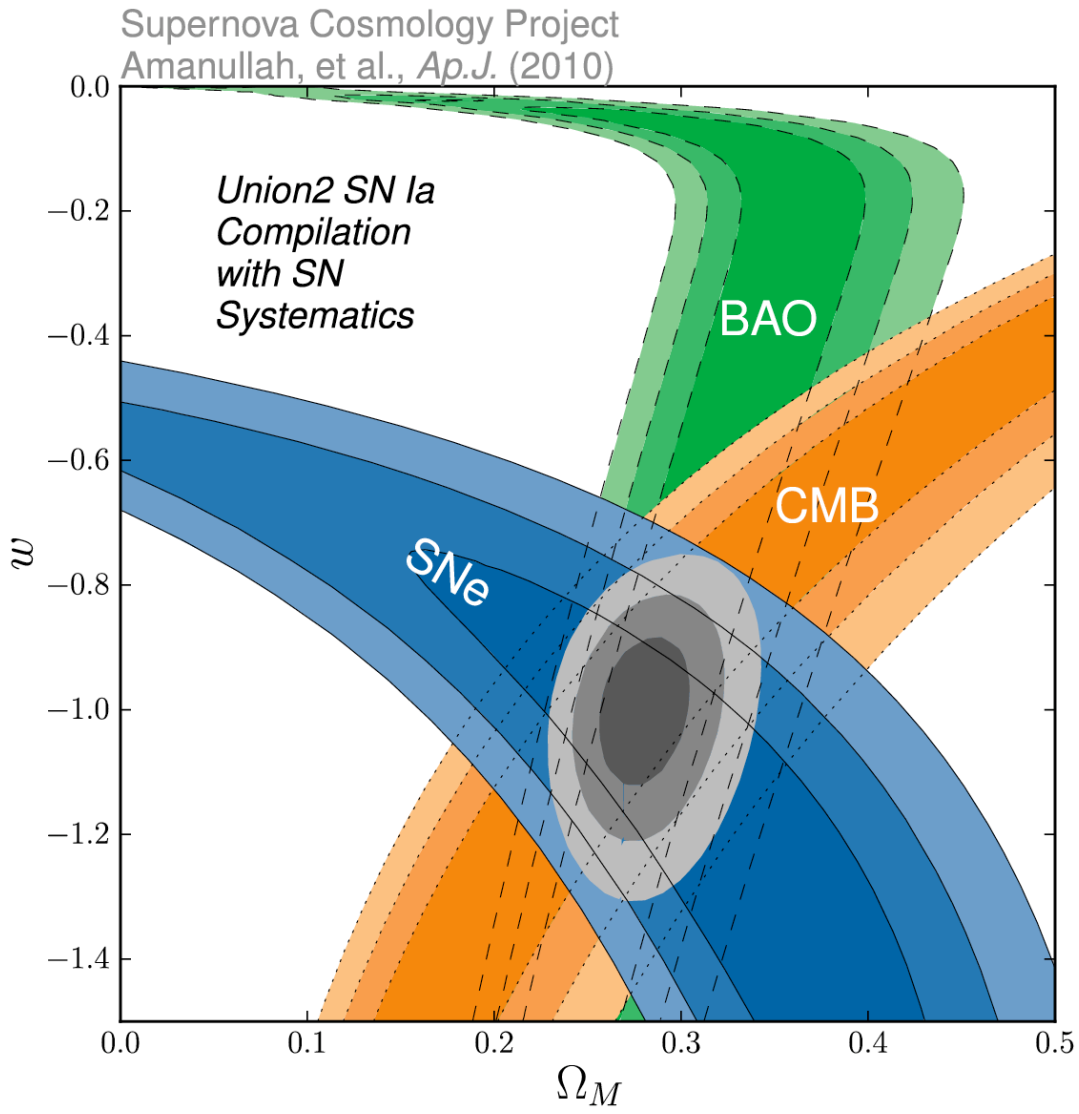
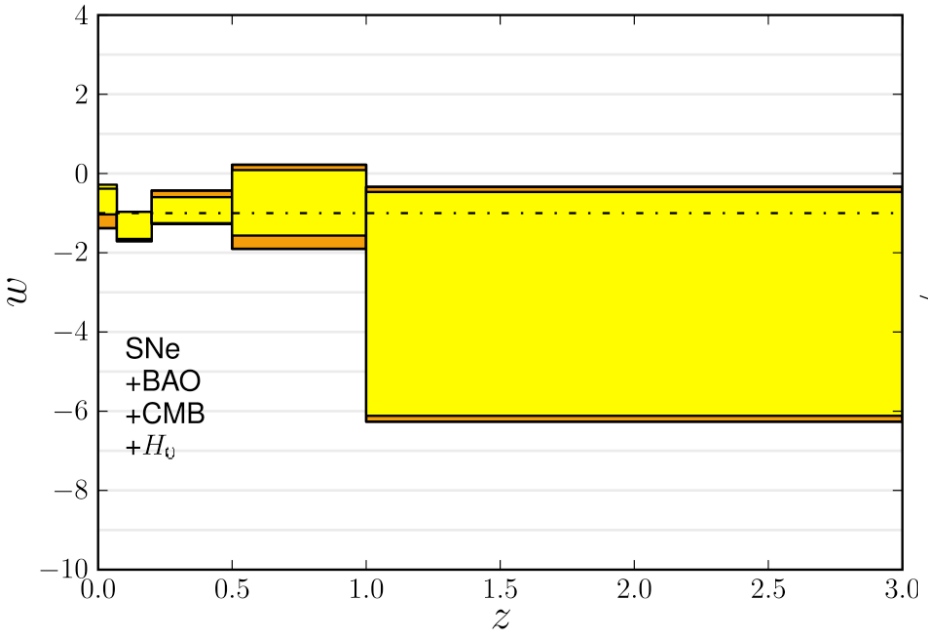


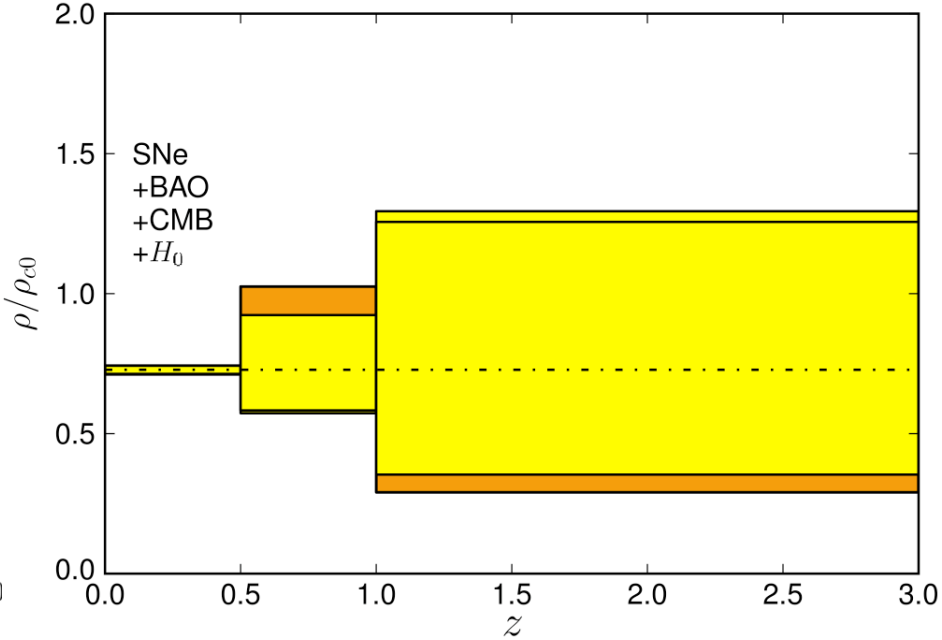
No statistically significant tensions when including systematics

Reasonable constraints on constant w: $-0.997^{+0.077}_{-0.082}$



…but no real constraint on $w(z > 0.5)$,





Statistical Errors Only
Including Systematics

or on the existence of dark energy a $z > 1$

Key Points

- Keeping the cosmology hidden while the analysis is finalized helps reduce biases
- Systematic errors are best handled as nuisance parameters which introduce correlations between supernova distances
- The Union2 compilation gives the strongest constraints yet, but there is considerable freedom for *w* to vary with time