Supernova Systematics:
Control through Focused Observations

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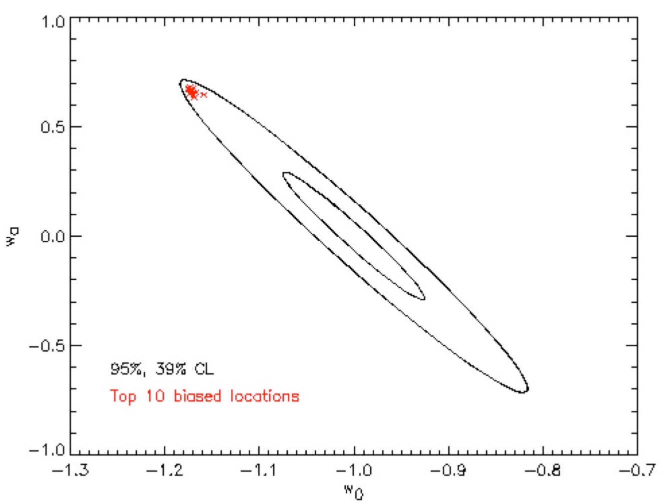

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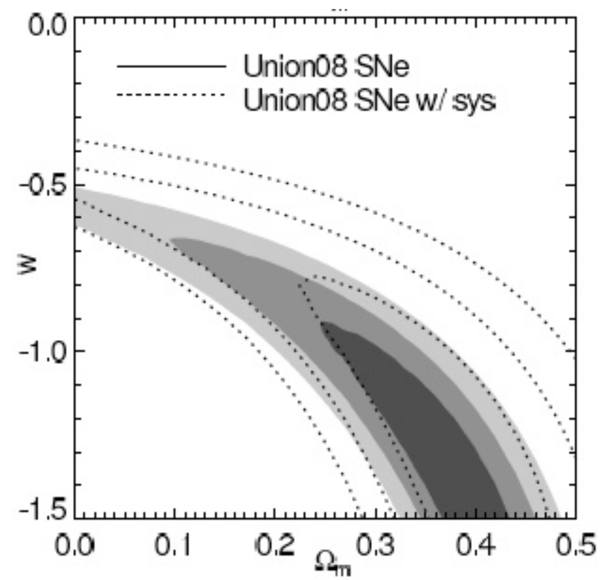


The Space of Systematics

Systematic residuals are unknown functions of redshift. Assuming a form f(z) may not fully account for the effects on cosmology.

We scan over every possible systematic, allowing for a constraint from observational data on the amplitude (or form). Uses a complete bin basis.

Propagate to cosmology bias and $\Delta\chi^2$.
Can determine which forms (in redshift or wavelength) have strongest effect.

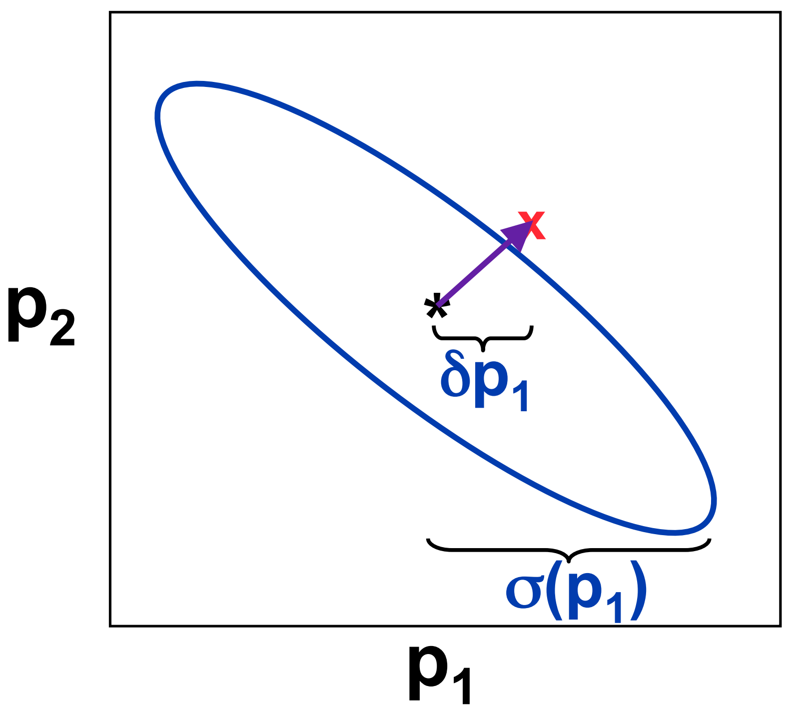
Samsing & Linder, arXiv:0908.2637

Measuring Bias

The bias on a parameter p_i can be compared to its uncertainty $\sigma(p_i)$, as in $\delta p_i/\sigma(p_i)$ but we also care about the covariance between parameters.
I.e. really care about shift in confidence contour.

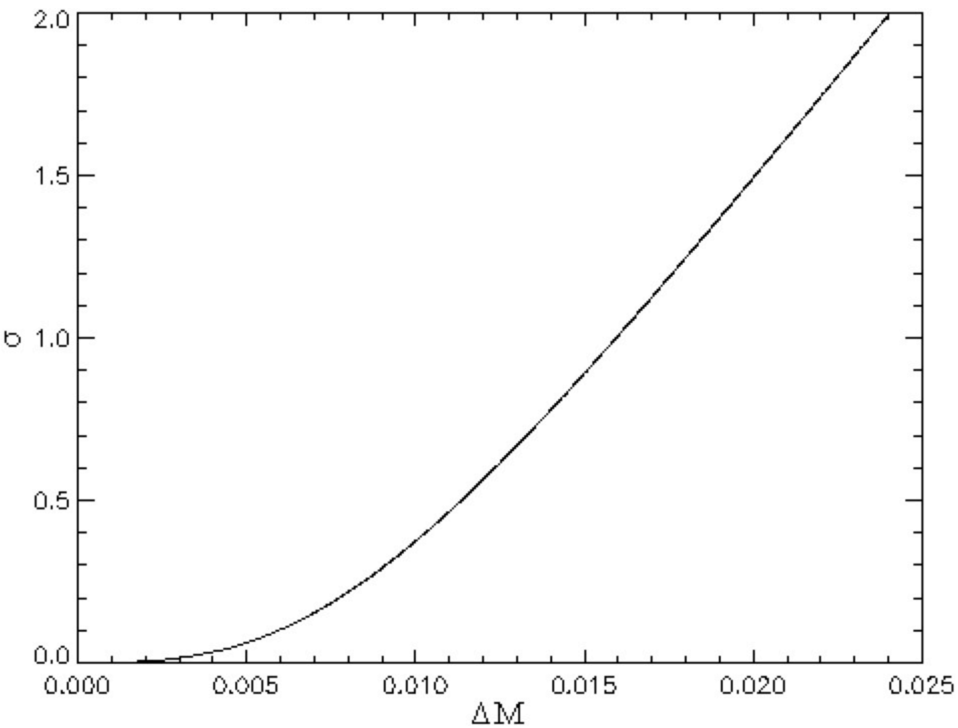
$$\Delta\chi^2 = \delta p \, F^{(r)} \, \delta p^T$$

Shapiro, arXiv:0812.0769

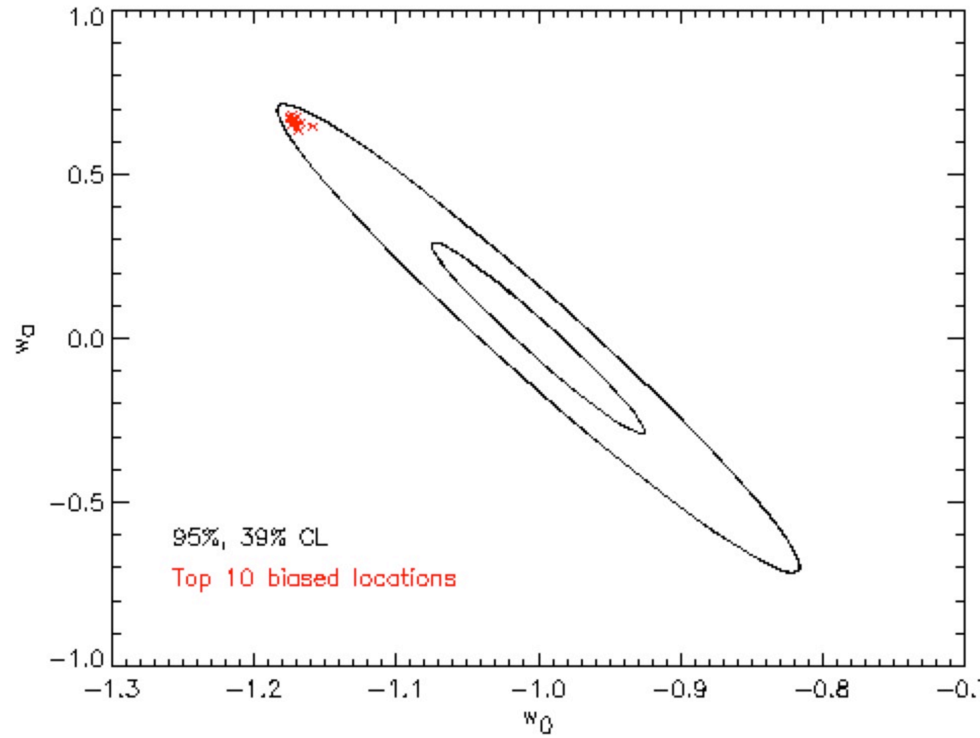


Population Drift

Unknown evolution of 2nd population fraction $f(z)-f(0)$, causing $\Delta m(z) = \Delta M\,[f(z)-f(0)]$.



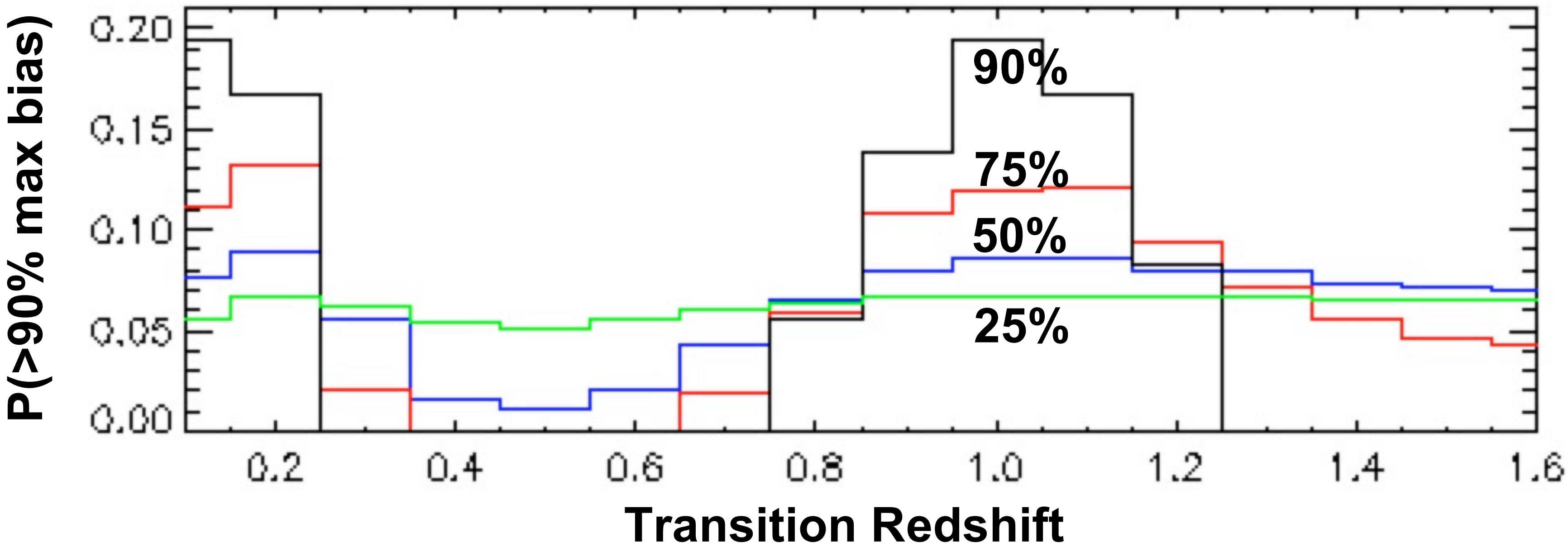
1σ bias on $\{\Omega_m, w_0, w_a\}$ for $\Delta M=0.016$ mag, with worst form of drift



Biases for 10 worst forms of drift, with $\Delta M=0.02$ mag

Redshift Focus

The worst biases come from population drift at localized redshifts: z~0.1 and z~1.0.



Observations to control systematics should be most comprehensive at these critical redshifts. Greatest danger from mixing samples at these z's, e.g. ground-space.

Dust Correction and Calibration

Need multiple wavelength bands for dust correction. Zeropoint offsets ΔZ_k give unknown, correlated systematic error $\Delta m(z)$.

cf. Kim & Miquel 2006
Nordin, Goobar, Jonsson 2008

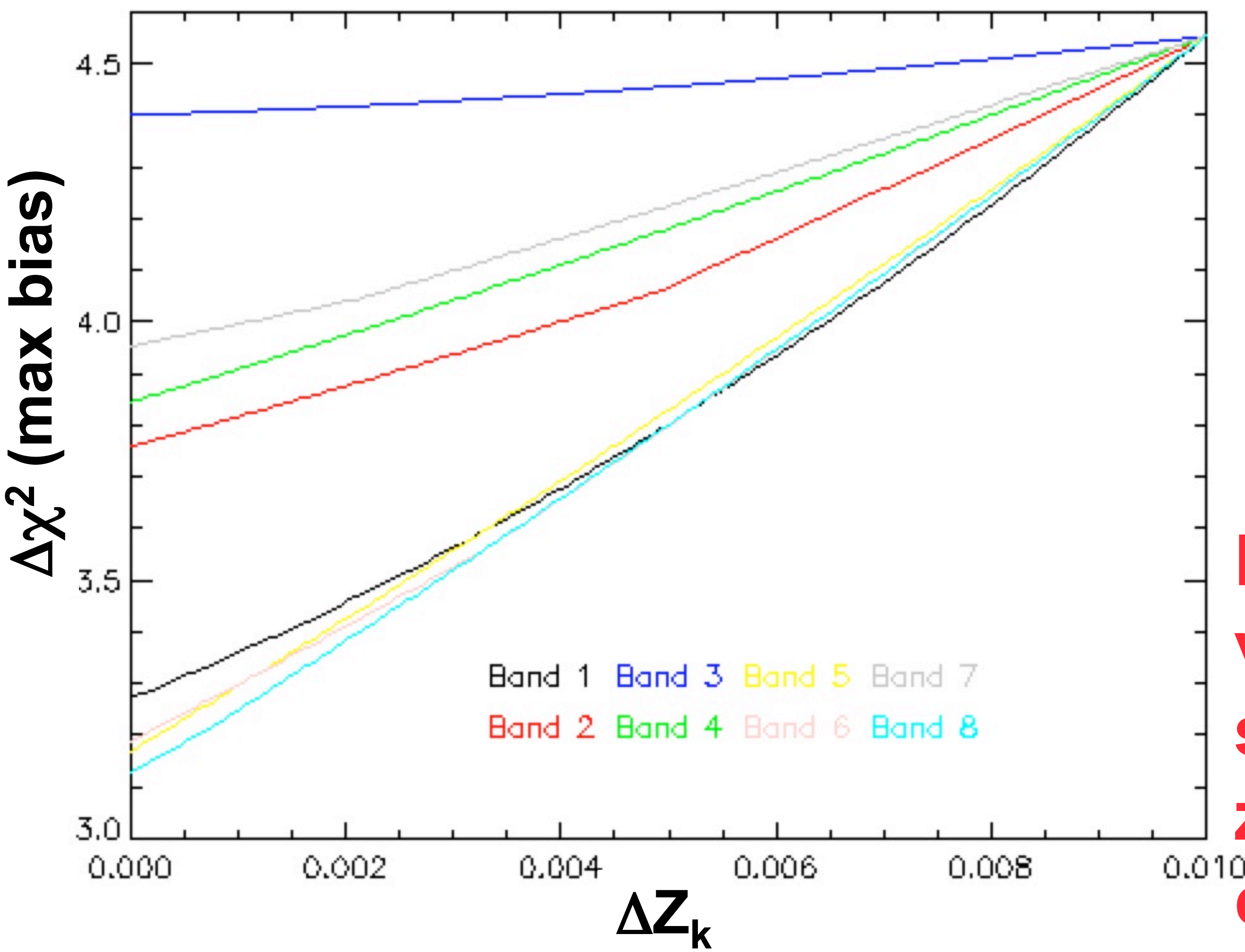
Model as 2 band dust correction with 8 logarithmic filters over 0.4-1.7 μm.

Maximum bias $\Delta\chi^2$ =4.1 for ΔZ_k=0.01 (0.02 color).

Relative flux (abs color) requirement for <1σ cosmology bias is 0.015 mag.

Wavelength Focus

Where in wavelength is greatest improvement for dust correction systematic?



Observer B, I, H bands (1,5,6,8).

That is, main bands for SN at z~0.1, z~1, z~1.7.

Don't mix separate visible and NIR surveys. Again, z~1 continuity is critical.

Conclusions

Efficient method for analyzing cosmology bias from all possible systematic forms (plus constraints).

Population drift control requires comprehensive observations especially at z~0.1, 1.0.

Dust correction/filter calibration control requires comprehensive observations especially at optical-NIR transition, eqv. z~1.0.

Systematics control strongly argues for homogeneous survey across z~1.0 and optical-NIR.