Dark energy constraints and correlations with systematics from CFHTLS weak lensing, SNLS supernovae Ia and CMB

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Data and model

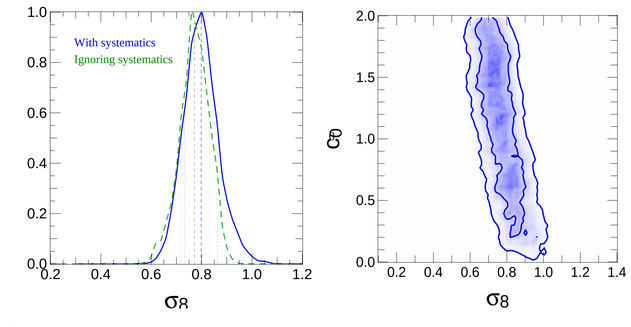
- Weak lensing: CFHTLS-Wide T0003 (57 sq. deg., Fu et al. 2008)
- Supernovae Ia: SNLS first-year (Astier et al. 2006)
- CMB: WMAP five-year (Hinshaw et al. 2008)

We constrain a flat dark-energy CDM model with constant w. It contains the following parameters:

- Cosmology (7): $\Omega_\mathrm{b}, \Omega_\mathrm{m}, \tau, w, n_\mathrm{s}, h, \sigma_8$
- Weak lensing: redshift distribution (3), high-z systematics (1)
- SNIa light-curve (3), photometric zero-point calibration (8)

Weak lensing systematics (1)

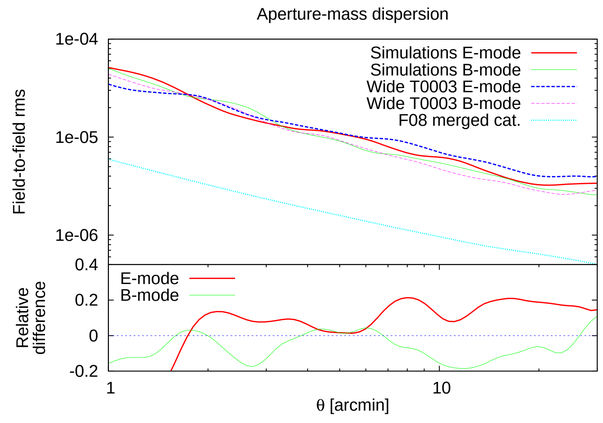
Preliminary analysis of CFHTLS T0004 (35 sq. deg., photo-zs from u^*, g', r', i', z', Coupon et al. 2008) shows the shear signal at high redshift to be systematically biased. We use a simple toy model and multiply the lensing efficiency with a calibration factor c_0 for $z > z_0 = 1$. We find $c_0 = 1.1 \pm 0.6$. Restricting $c_0 < 1$ (systematic shear underestimation) leads to a bias for σ_8 of 8%.



Correlation between σ_8 and the multiplicative weak-lensing bias c_0. A systematic under-estimation of the lensing signal at high z causes σ_8 to be over-estimated.

Weak lensing systematics (2)

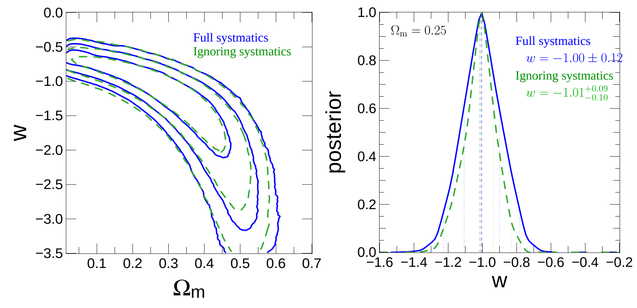
We use N-body simulations to model the field-to-field variation of the lensing signal between MegaCam pointings (1 sq. deg.). We find an observed E-mode rms which is 5%-15% larger than predicted. Note that variations in the mean redshift is not taken into account, this will decrease the relative difference by another 5%.



Predicted (from N-body/ray-tracing simulations) and observed field-to-field rms.

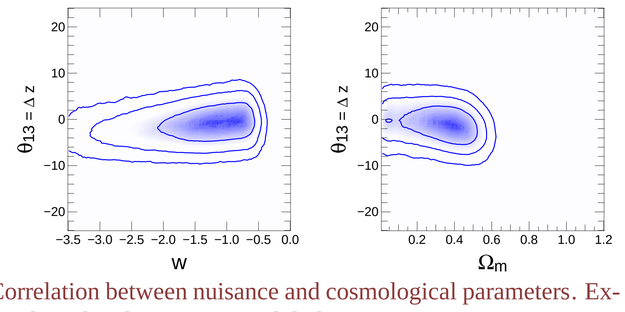
SNIa systematics

We model the response of the distance module to photometric zero-point shifts in each of the seven filters g, r, i, z, U, B, V and the Vega $B-V$ color in the Landolt system. This uncertainty increases the error bars and causes correlations with cosmological parameters.



Increase of error bars due to the inclusion of systematic effects (uncertainty in photometric zero-point calibration).

Errors in the photometric zero-point calibration cause the luminosity distances to be systematically biased. This has an effect on cosmological parameters.



Correlation between nuisance and cosmological parameters. Example: z-band zero-point and dark-energy eos w:

$$\Delta w(\Omega_\mathrm{m} = 0.25) = -0.0135 \frac{\Delta z}{0.03\,\mathrm{mag}}$$

References

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- Fu, L., Semboloni, E., Hoekstra, H., Kilbinger, M. et al. 2008, A&A, 479, 9
- Hinshaw, G., Weiland, J.L., Hill, R.S. et al. 2008, astro-ph/0803.0732
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Cosmological constraints