Mitigation Strategies for WFIRST Weak Lensing Systematics

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What is the dominant systematic for WL ?

Wrong question! Try again…

What is the dominant systematic for WL
… given a

1. Mission (instrument/survey parameters)
2. Data Vector
3. Science Case
4. Description of the Systematics

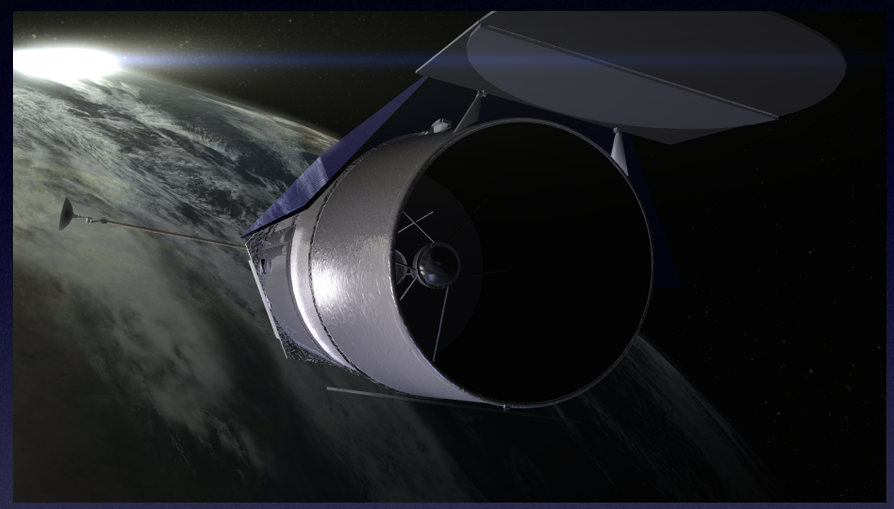
… ?

Simulated Likelihood Analyses

1. Mission (Instrument/Survey Parameters

WFIRST

- 2500 deg^2
- 60 gal/arcmin^2
- shape noise=0.26



Redshift distribution

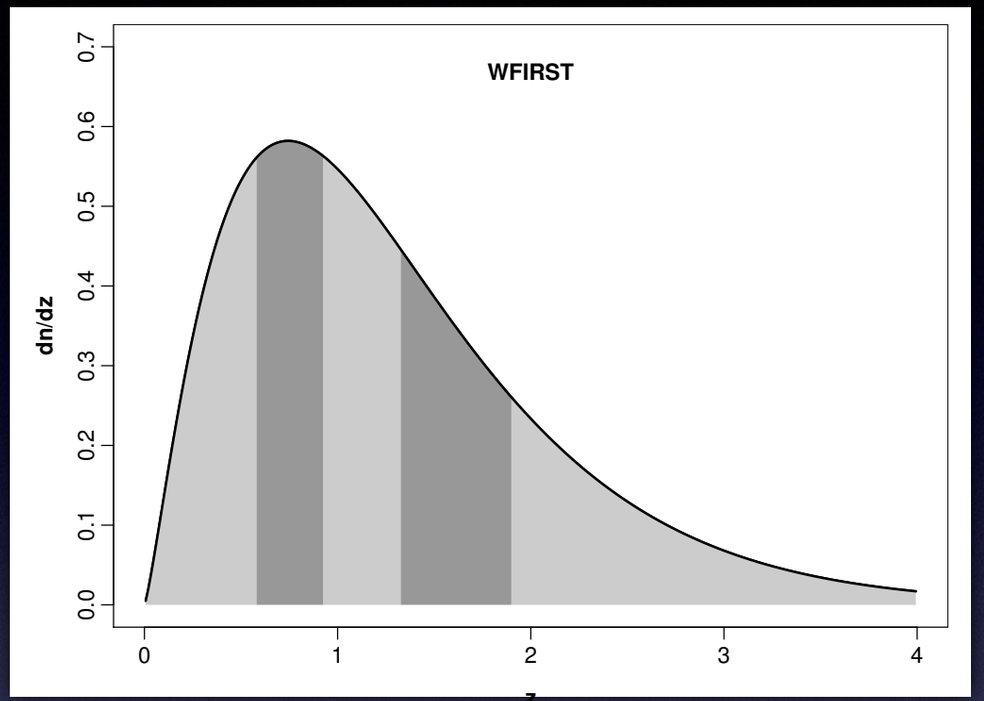
- Similar parameterization as LSST (Chang et al 2013)
- Choose deeper mean redshift, higher z_{max}

2.Data Vector

Shear tomography power spectra

Binning Specs

- 5 tomography bins
- 12 l-bins (100-5000)
- 180 CLs in total

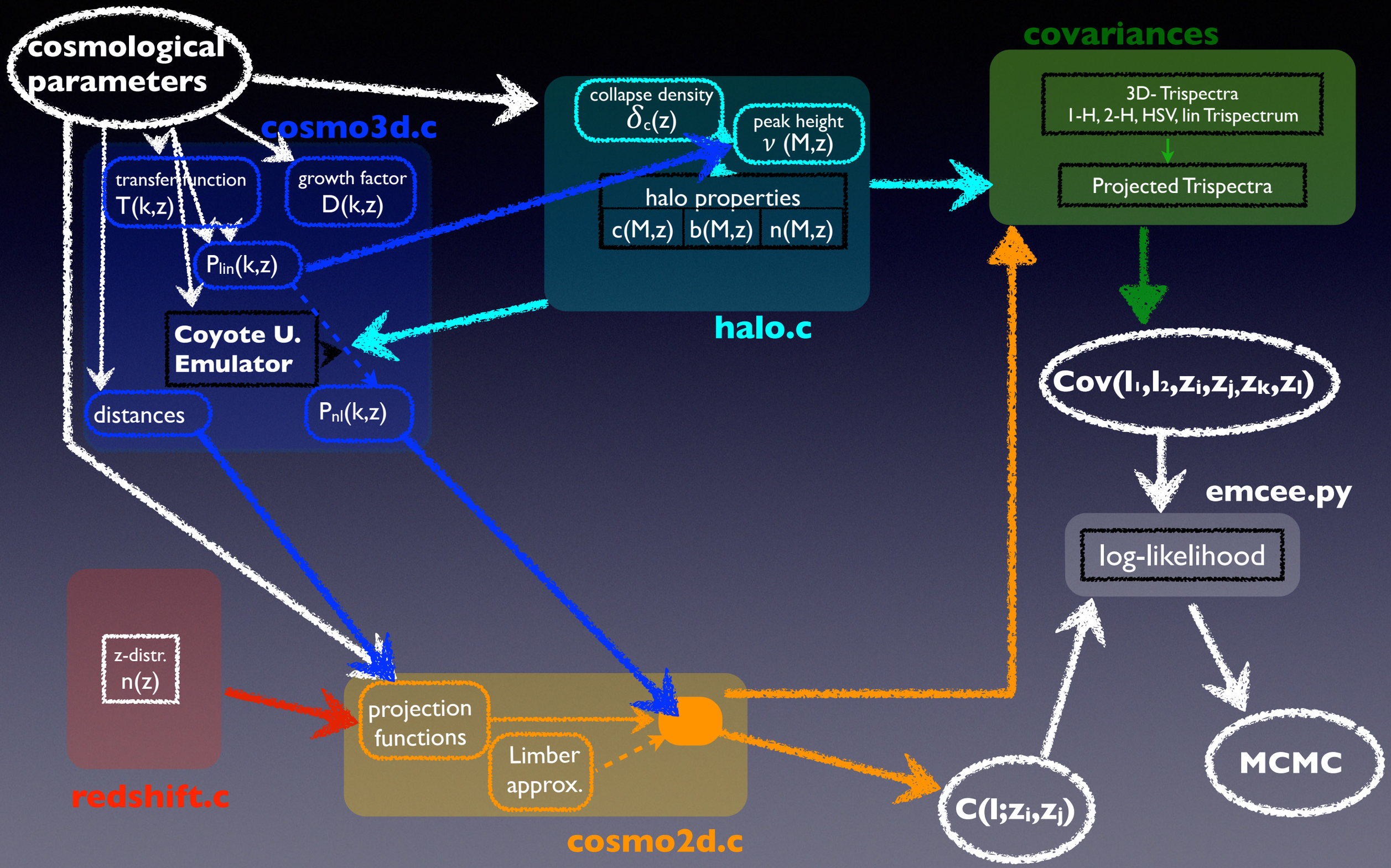


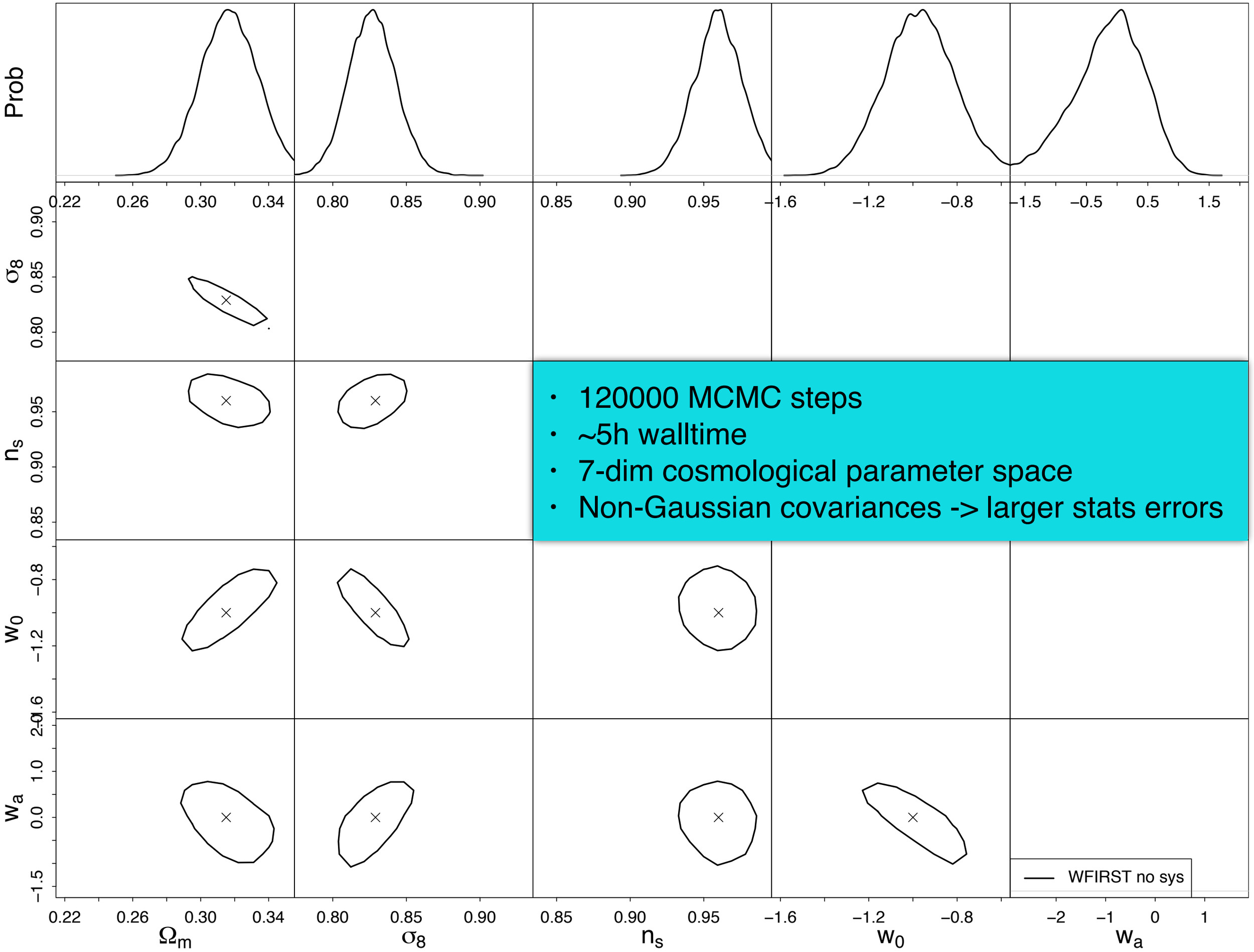
In the process of being updated using WFIRST ETC.
Project with Sergi Hildebrandt, Chris Hirata, Charles Shapiro et al

3.Science Case

Ω_m	σ_8	n_s	w_0	w_a	Ω_b	h_0
0.315	0.829	0.9603	-1.0	0.0	0.049	0.673

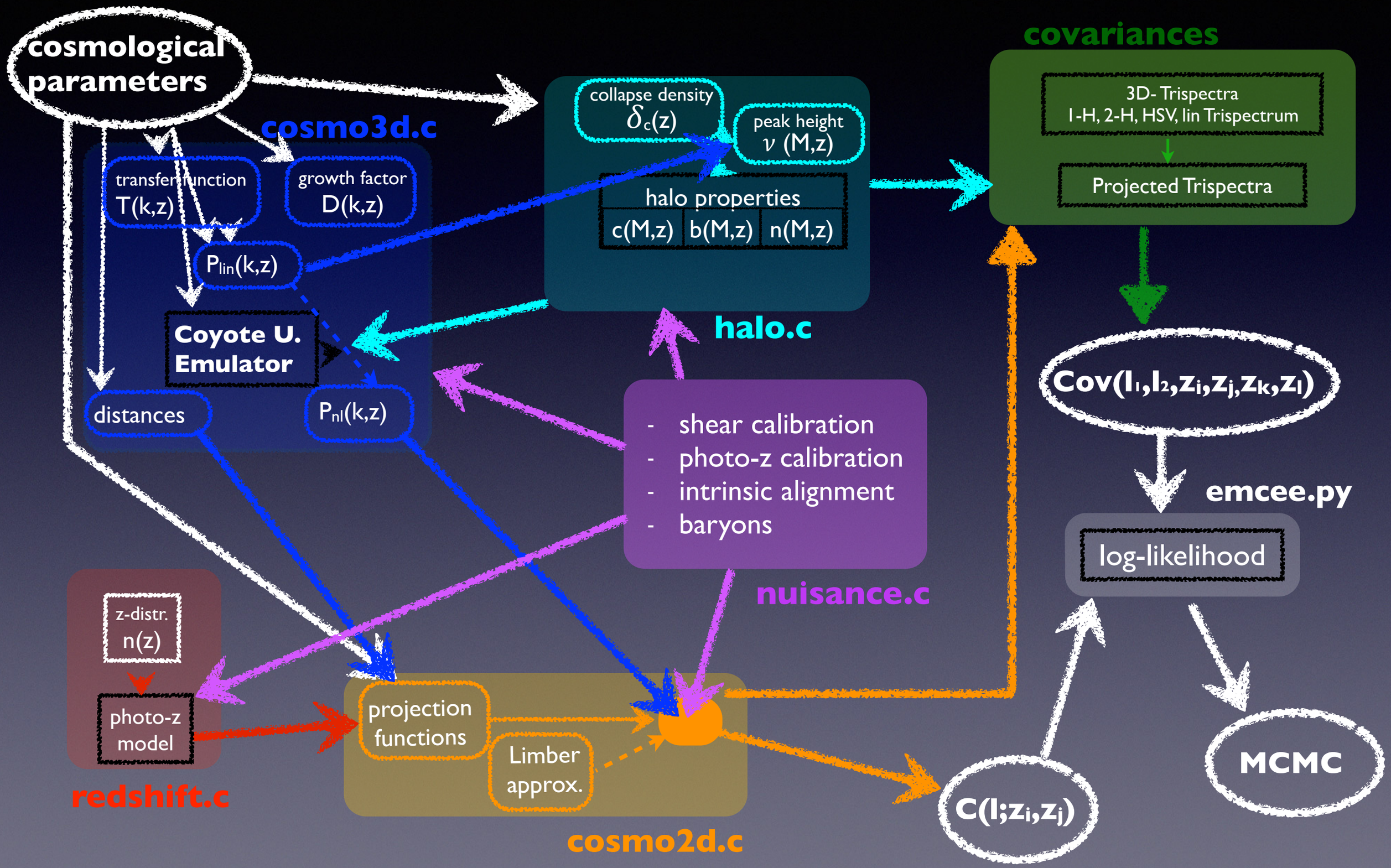
CosmoLike WL module - No Systematics





- 120000 MCMC steps
- ~5h walltime
- 7-dim cosmological parameter space
- Non-Gaussian covariances -> larger stats errors

4. Description of Systematics

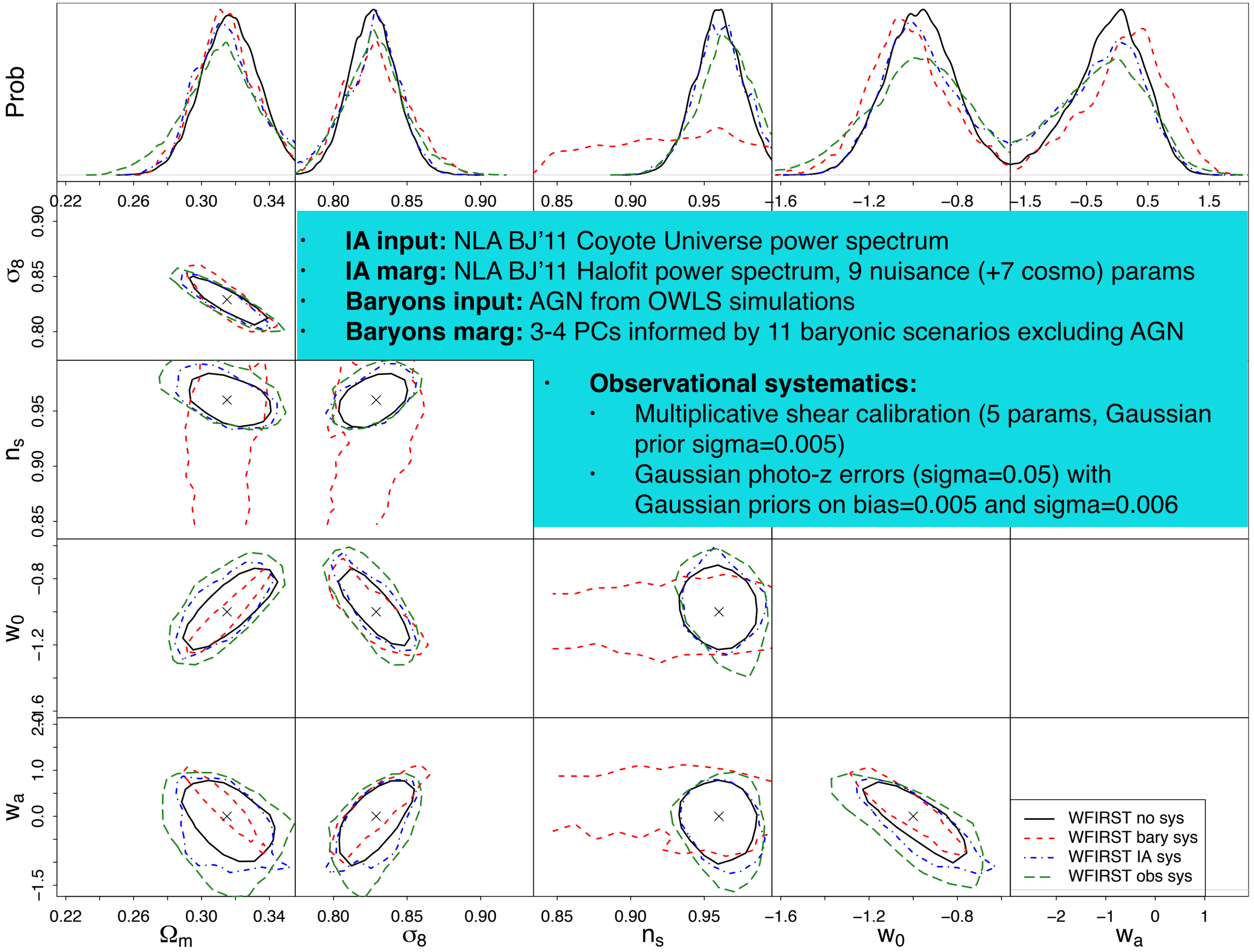


$$C_{\rm II}(\ell) = f_{\rm red}^2 \int_0^{\chi_h} {\rm d}\chi \, \frac{p^2(\chi)}{\chi^2} \, P_{\rm II}\,(k,\chi)\,, \qquad P_{\delta{\rm I}}(k,z,L) = -A\,C_1\,\rho_{\rm cr}\,\frac{\Omega_{\rm m}}{D(z)} P_\delta(k,z) \left(\frac{1+z}{1+z_0}\right)^{\eta_{\rm other}} \left(\frac{L}{L_0}\right)^{\beta}$$

$$C_{\rm GI}(\ell) = f_{\rm red} \int_0^{\chi_h} {\rm d}\chi \, \frac{p(\chi)\,q(\chi)}{\chi^2} \, P_{\delta{\rm I}}\,(k,\chi) \qquad P_{\rm II}(k,z,L) = A^2\,C_1^2\,\rho_{\rm cr}^2\,\frac{\Omega_{\rm m}^2}{D^2(z)} P_\delta(k,z) \left(\frac{1+z}{1+z_0}\right)^{2\eta_{\rm other}} \left(\frac{L}{L_0}\right)^{2\beta}$$

- **IA input:** NLA BJ'11 Mega-z model
- $f_{\rm red}$ computed from extrapolated LF from GAMA, DEEP2
- **Baryons input:** AGN from OWLS simulations

WFIRST no sys
WFIRST bary impact
WFIRST IA impact

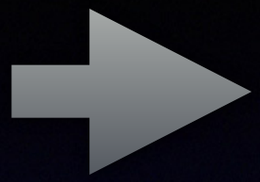


- **IA input:** NLA BJ'11 Coyote Universe power spectrum
- **IA marg:** NLA BJ'11 Halofit power spectrum, 9 nuisance (+7 cosmo) params
- **Baryons input:** AGN from OWLS simulations
- **Baryons marg:** 3-4 PCs informed by 11 baryonic scenarios excluding AGN

- **Observational systematics:**
  - Multiplicative shear calibration (5 params, Gaussian prior sigma=0.005)
  - Gaussian photo-z errors (sigma=0.05) with Gaussian priors on bias=0.005 and sigma=0.006

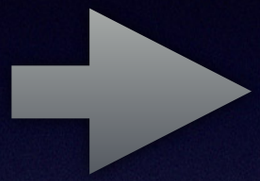
Systematics Mitigation Plan

Accurate parameterizations for systematics



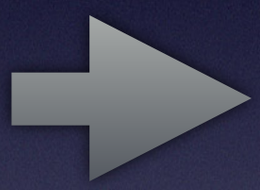
Observations/Mocks/ Theory feedback loop

Strong priors on these nuisance parameters



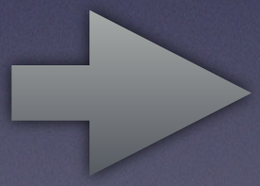
Targeted estimators for systematics - ext. data/other probes

Reduce the number of nuisance parameters account for correlations



PCA Marginalization (TE, Krause, et al 2014)

- Test Impact of all sorts of sys (instrument/survey strategy)
- Test scale+redshift dependence
- Test degeneracy with cosmology



Simulated Analyses

Ultimate solution to WL systematics:
Multi-probe analysis with consistent, forward modeling of all systematics

- Different IA input models, all analyzed with NLA BJ'11

WFIRST no sys
WFIRST IA CE HF
WFIRST IA lin HF
WFIRST IA DK HF

Prob

Ω_m σ_8 n_s w_0 w_a

CosmoLike Core Routines

basics.c

recompute.c

parameters.c

cosmo3D.c

redshift.c

IA.c

HOD.c

halo.c

baryons.c

EBfunctions.c

compression.c

cosmo2D_ggl.c

cosmo2D_cl.c

cosmo2D_mag.c

cosmo2D_wl.c

CMBxLSS.c

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