



Optimizing galaxy samples for clustering measurements in photometric surveys



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with

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DES Y1

Galaxy clustering: **redMaGiC**

accurate photo-zs: $\sigma_z/(1+z) < 0.017$

small (~ 660000 galaxies)



Q: Can we **extend** the sample in future analyses?

Related work: Optimized sample for Y1 BAO measurements (M. Crocce et. al. arXiv: 1712.06211)

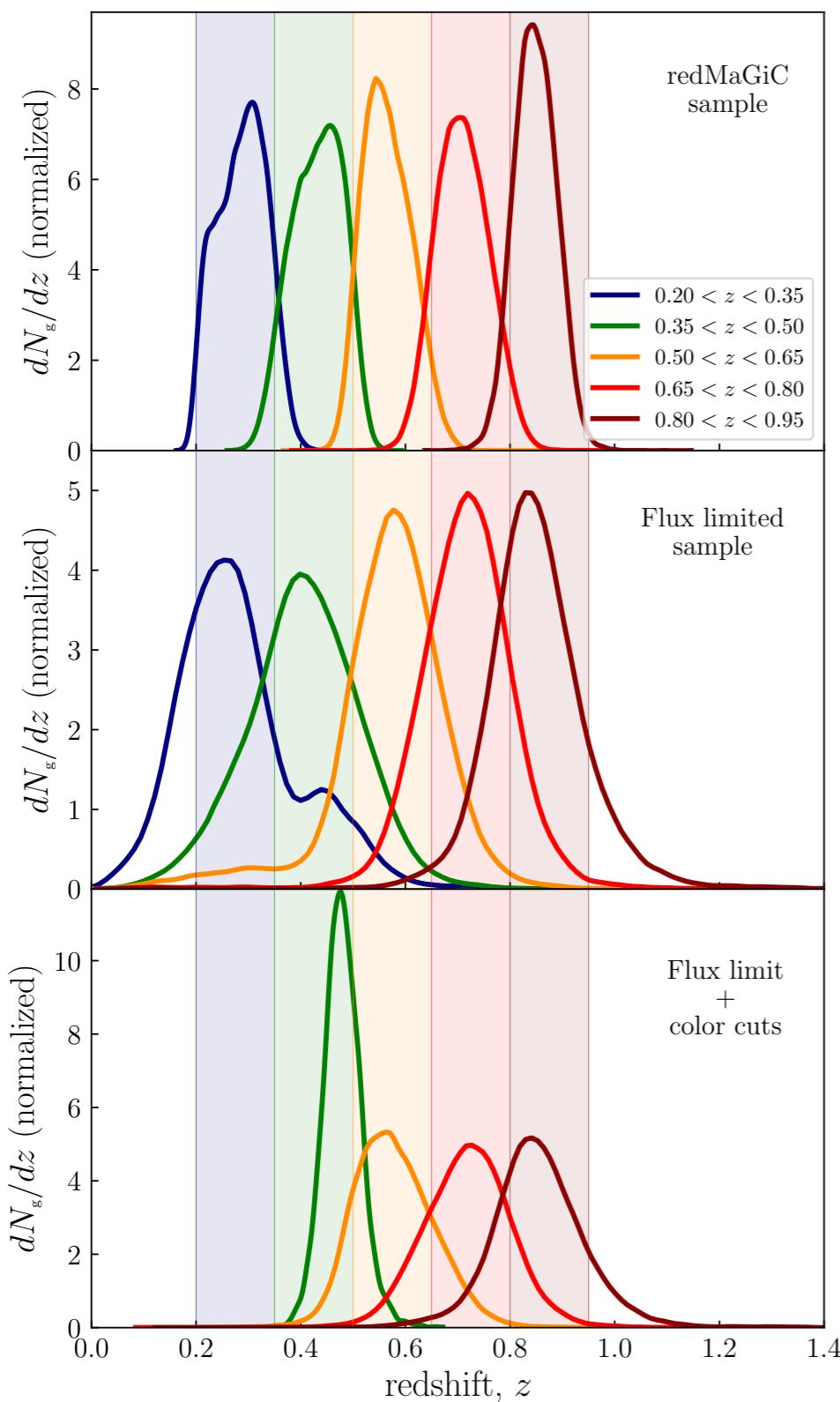
Alternative lens sample in Y3 (A. Porredon, M. Crocce et. al.)

Make it general:

- Adopt a simple **model**
- Explore the $\sigma_{z,0}$ - N_g parameter space

Redshift distributions from data

Model



- Gaussian photo-zs:

$$p^i(z_{\text{ph}}|z) = \frac{1}{\sqrt{2\pi}\sigma_z} \exp \left[-\frac{(z_{\text{ph}} - z - z_b^i)^2}{2\sigma_z^2} \right]$$

$$\sigma_z = \sigma_{z,0}(1+z)$$

- Common underlying redshift distribution:

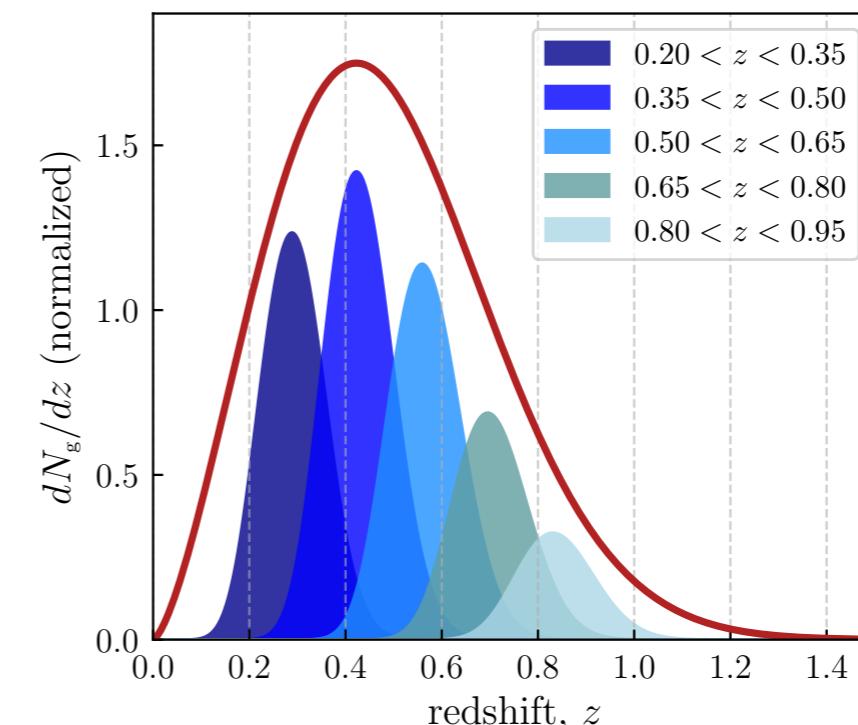
$$\frac{dN_g}{dz} \propto z^\alpha \exp \left[-\left(\frac{z}{z_0} \right)^\beta \right]$$

$$z_0 = 0.5$$

$$\alpha = 1.47$$

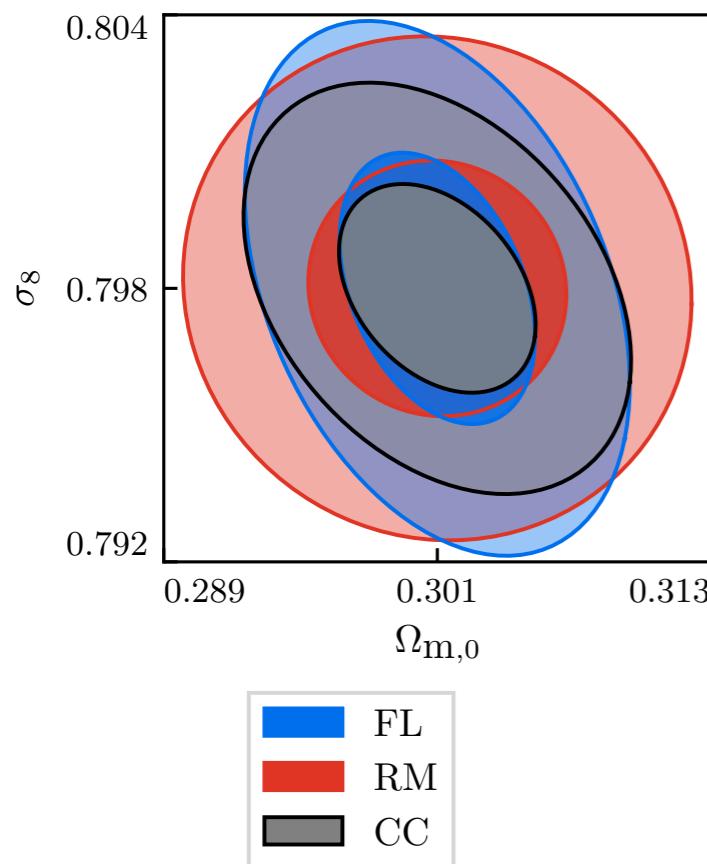
$$\beta = 2.09$$

- Priors: $\sigma(\sigma_{z,0}) = \sigma(z_b^i) \propto \sigma_{z,0}$

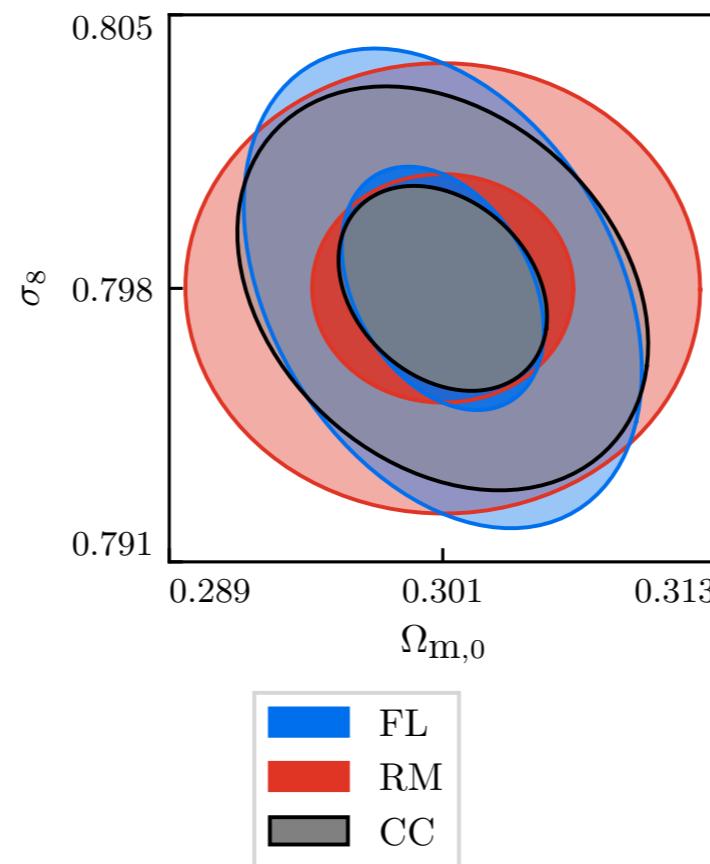


Forecasts

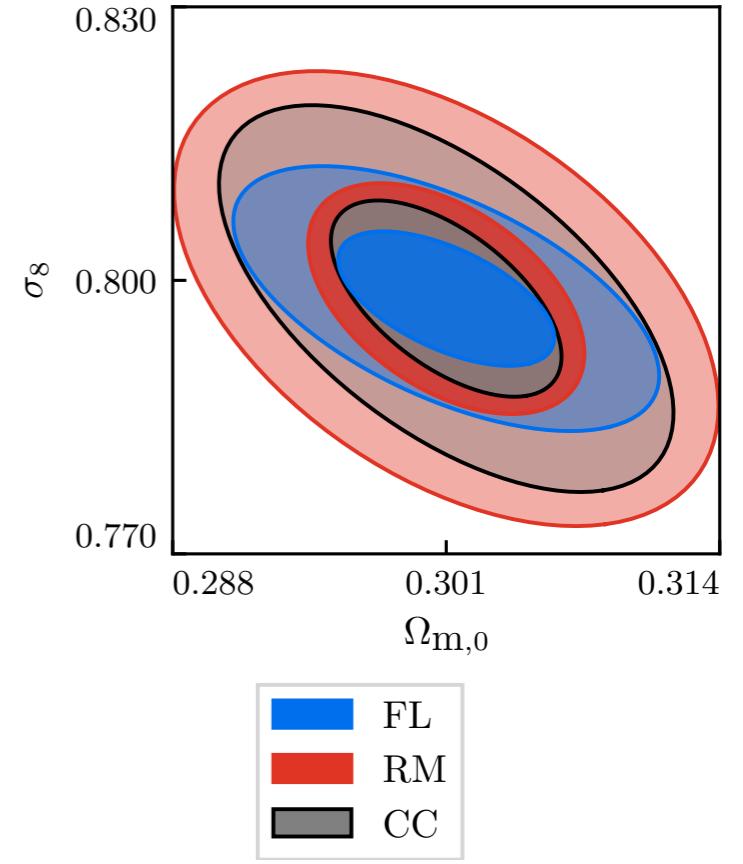
From data



Model (fixed scatter)



Model (free scatter)



Scaled to Y3 footprint

**Forecasts from clustering only
keeping other cosmological and nuisance parameters fixed in their fiducial values**

Wide range of samples:

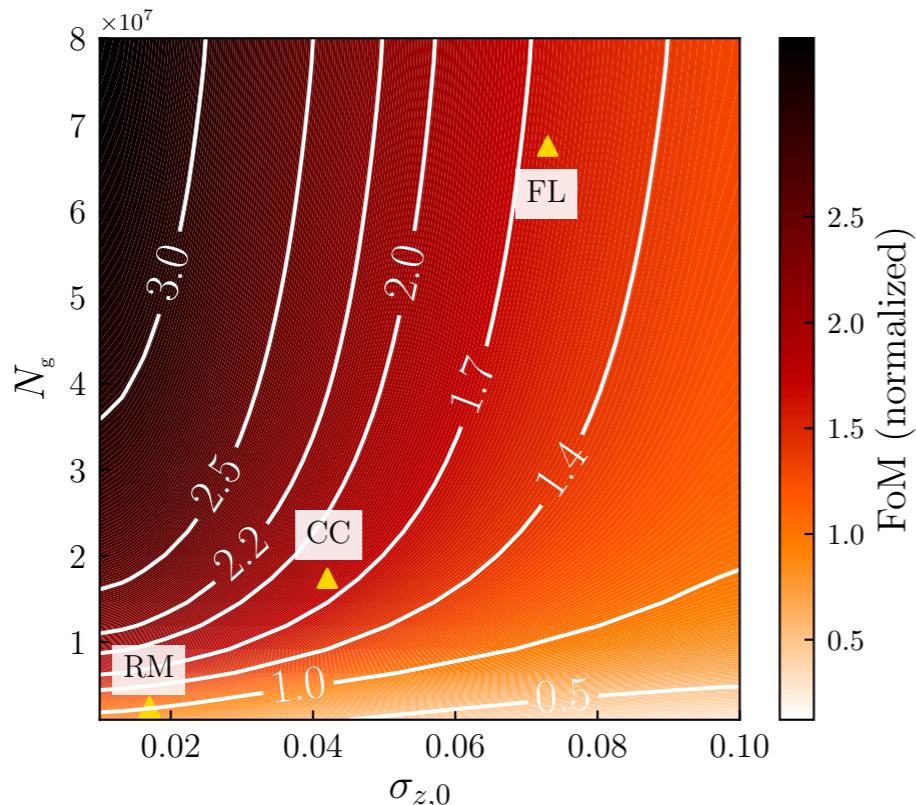
Figure of Merit (FoM) for: $\Omega_m - \sigma_8$

Auto-Correlations only

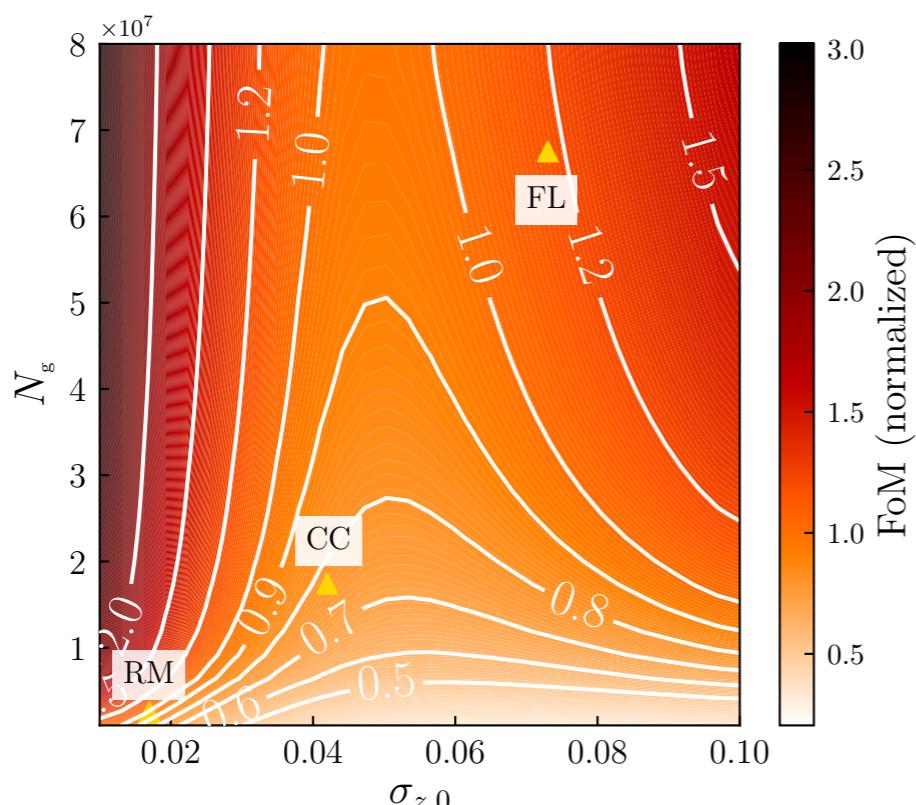
RM:
redMaGiC

FL:
flux limited

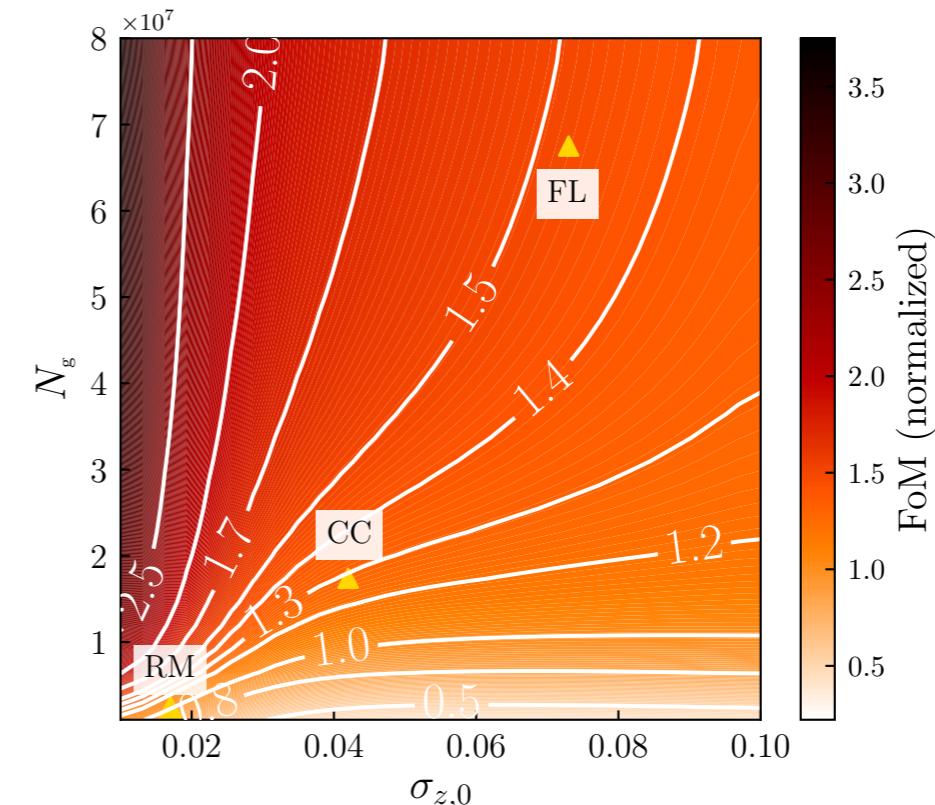
CC:
color cuts



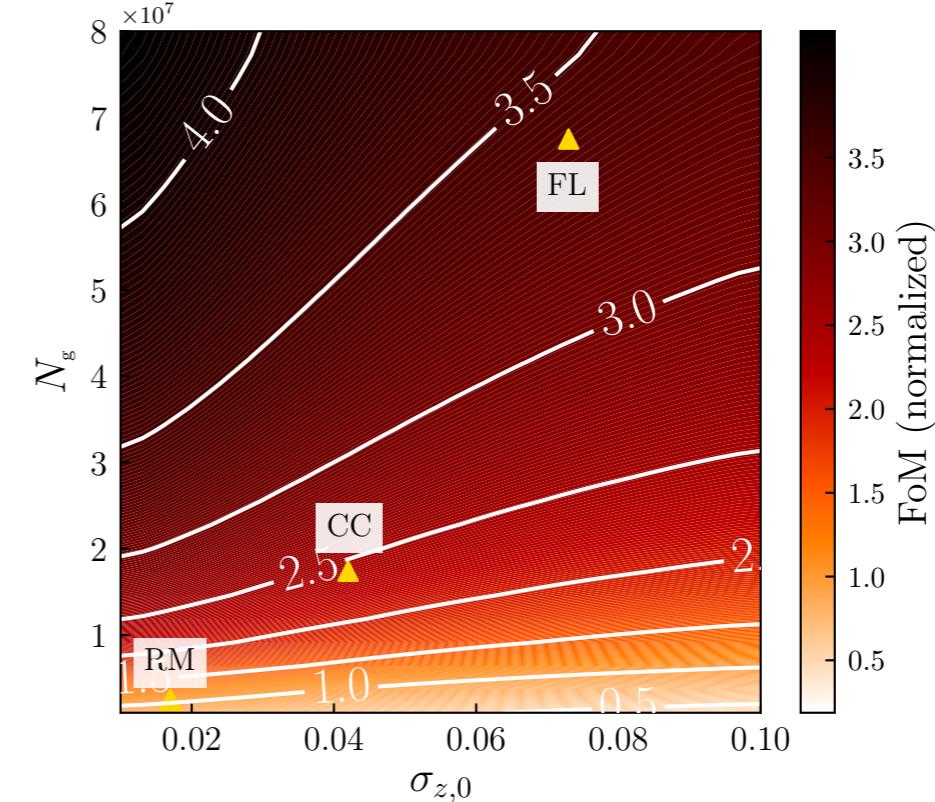
Free photo-z parameters



Optimistic priors $\sigma(\sigma_{z,0}) = \sigma(z_b^i) = 0.04\sigma_{z,0}$



Conservative priors $\sigma(\sigma_{z,0}) = \sigma(z_b^i) = 0.4\sigma_{z,0}$



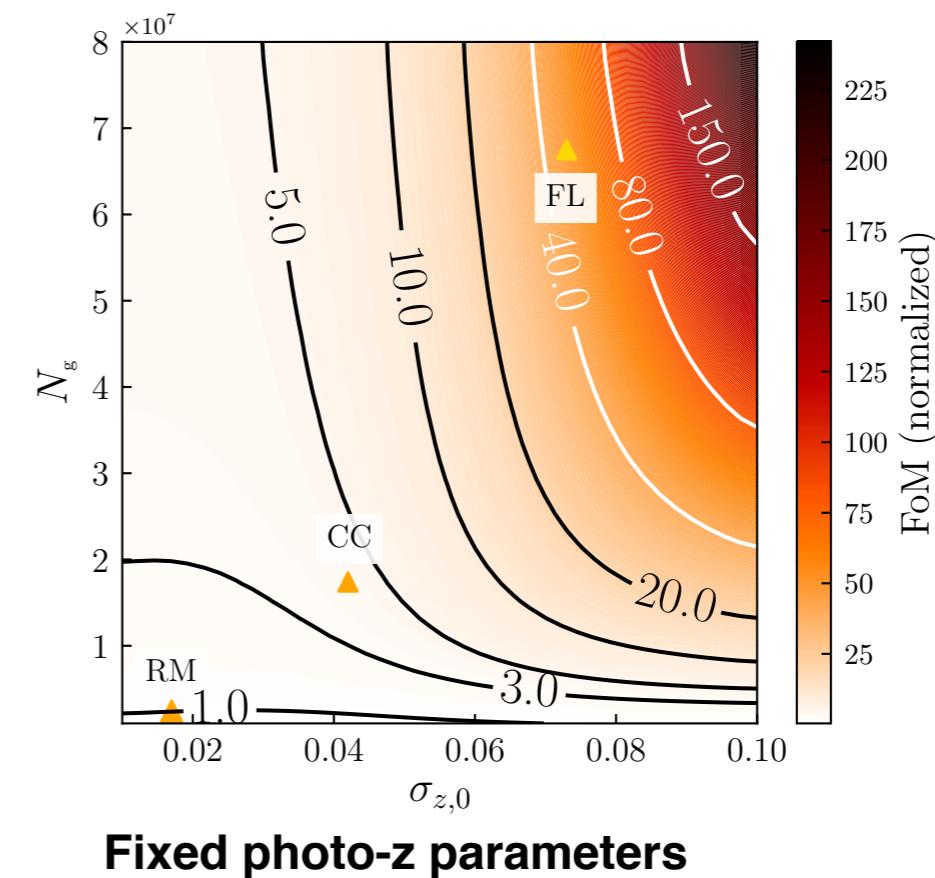
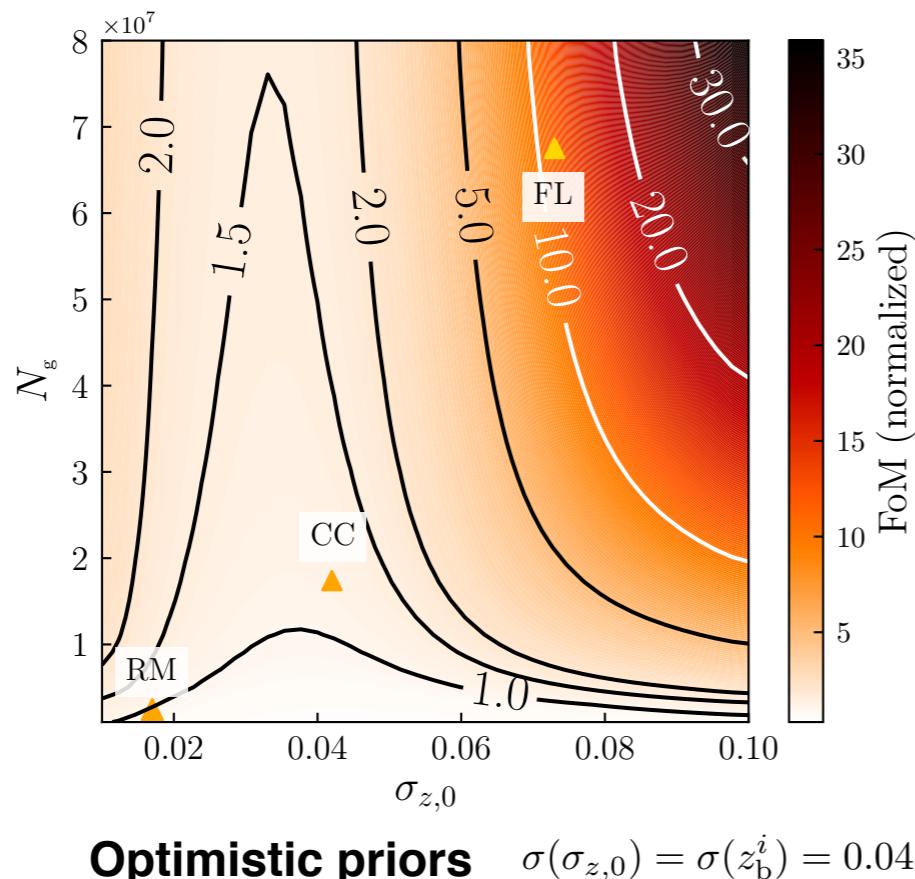
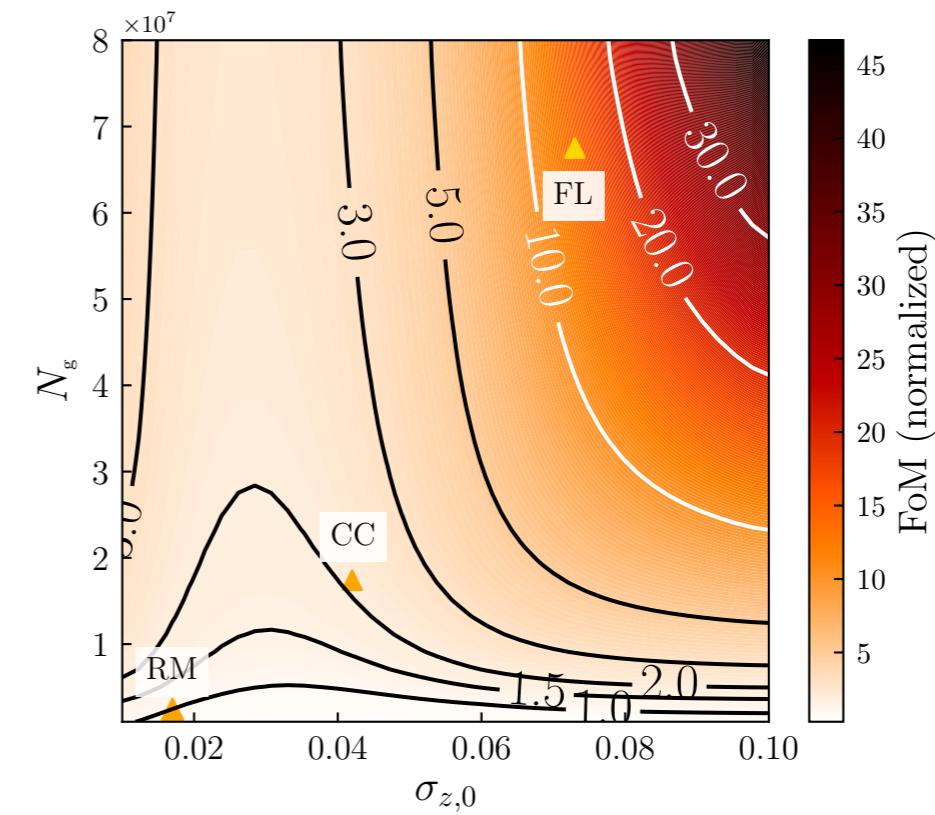
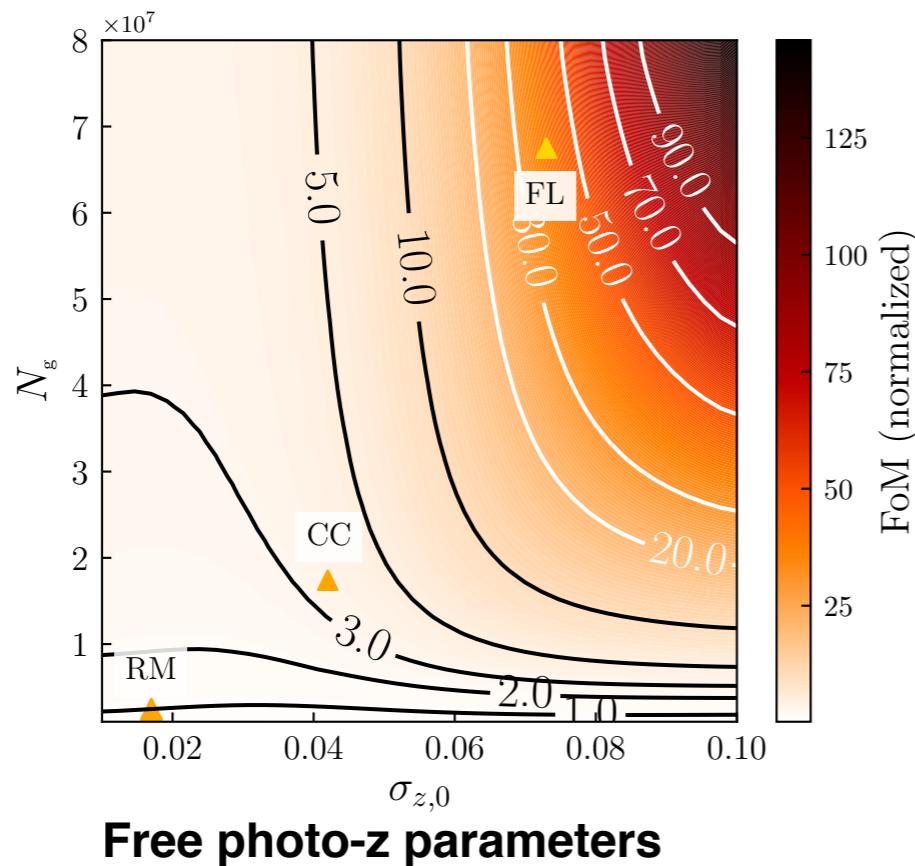
Fixed photo-z parameters

Auto- and Cross-correlations

RM:
redMaGiC

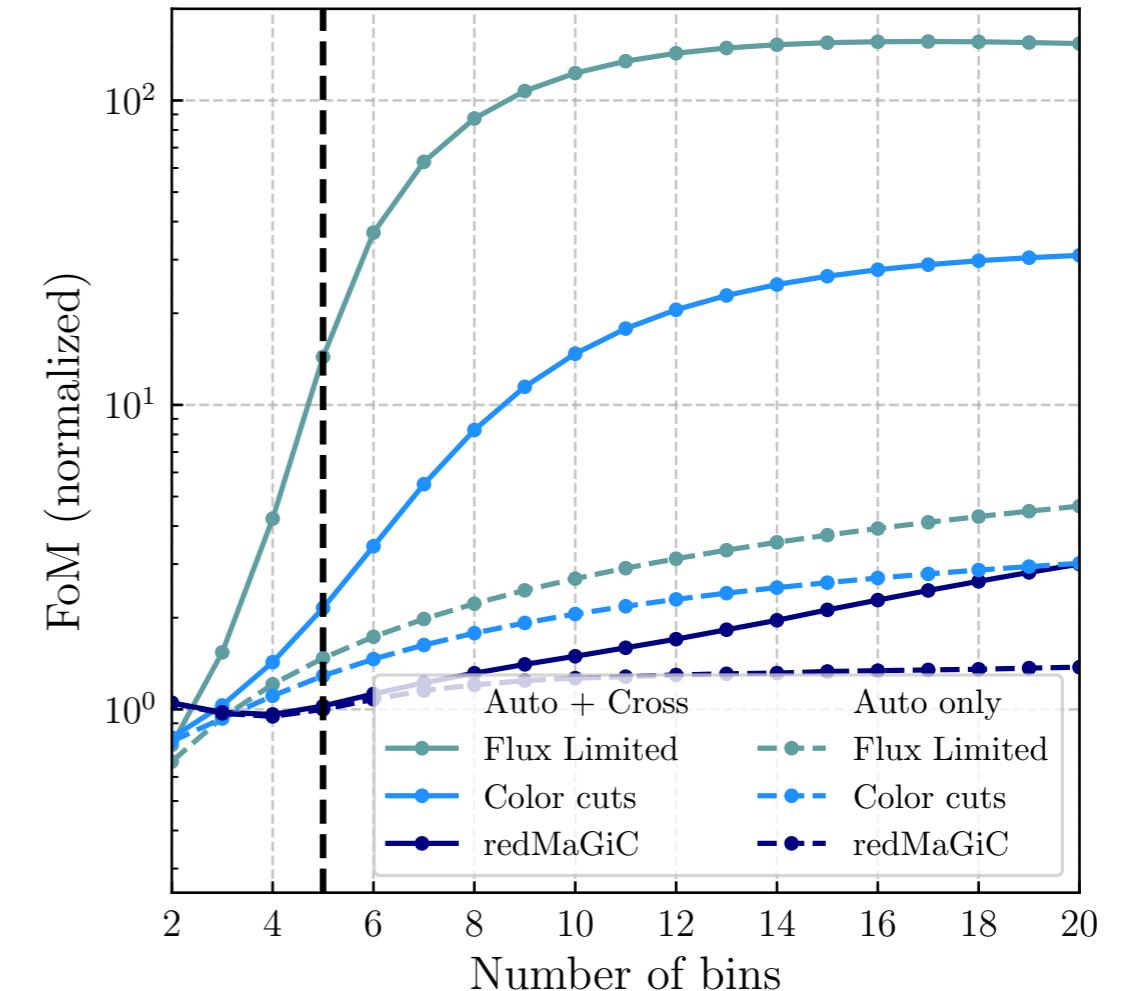
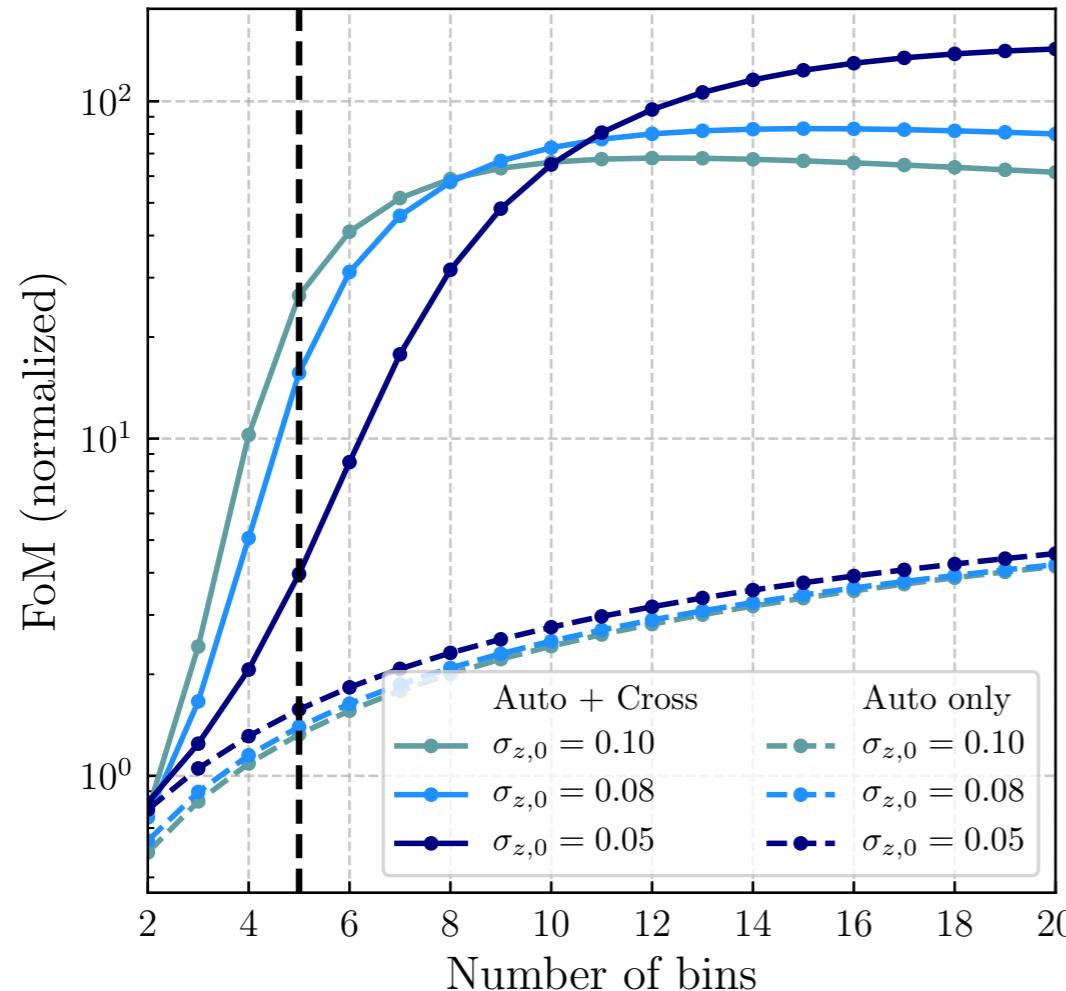
FL:
flux limited

CC:
color cuts



Dependence on the bin size

(or number of bins)



All samples have size: $N_g = 4 \times 10^7$
galaxies

Conclusions

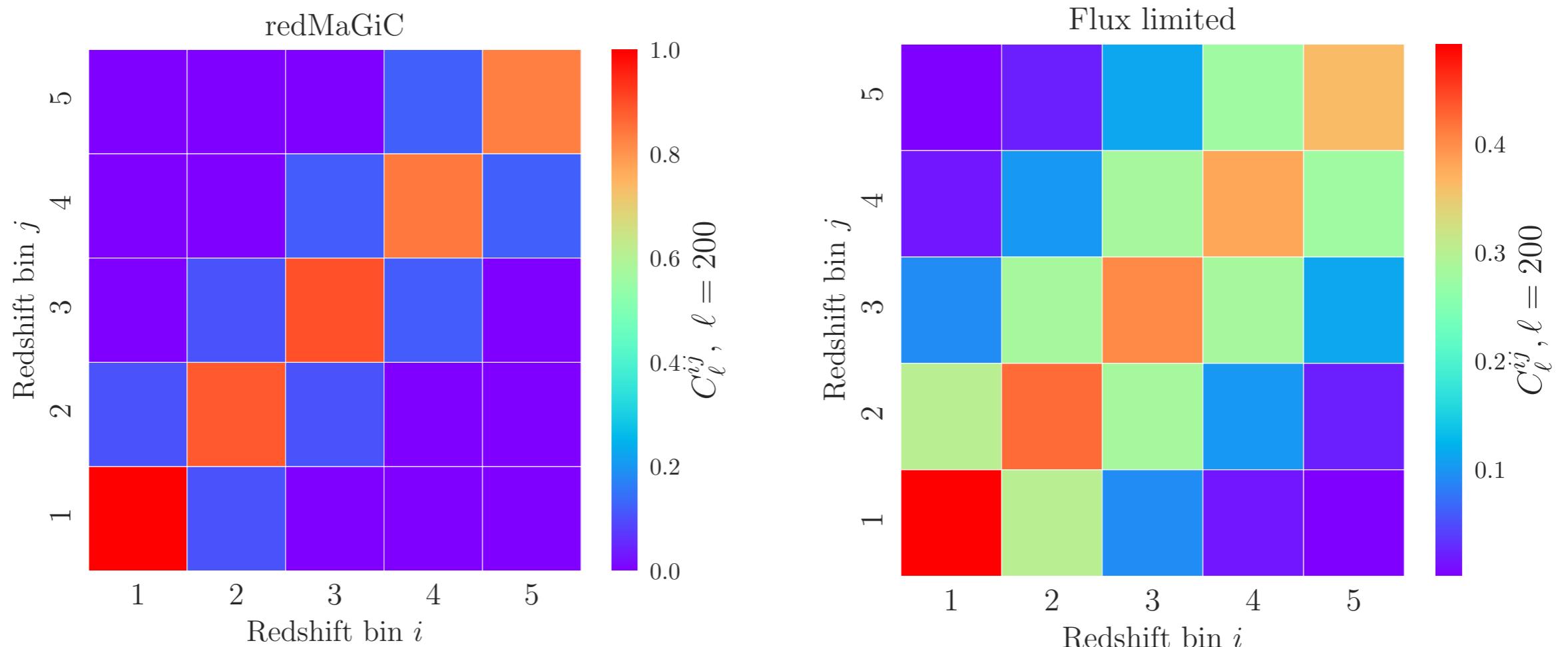
- Adopting a simple model —> Explore the photo-z error - sample size parameter space.
- When auto-correlations only: marginal gains from moving to larger, worse photo-z samples
- With cross-correlations: significant gains from moving to larger, worse photo-z samples (overlap between bins)
- Thinner binning benefits samples with more accurate photo-zs

Project **not** part of DES Y3KP, but happy if I can contribute!!

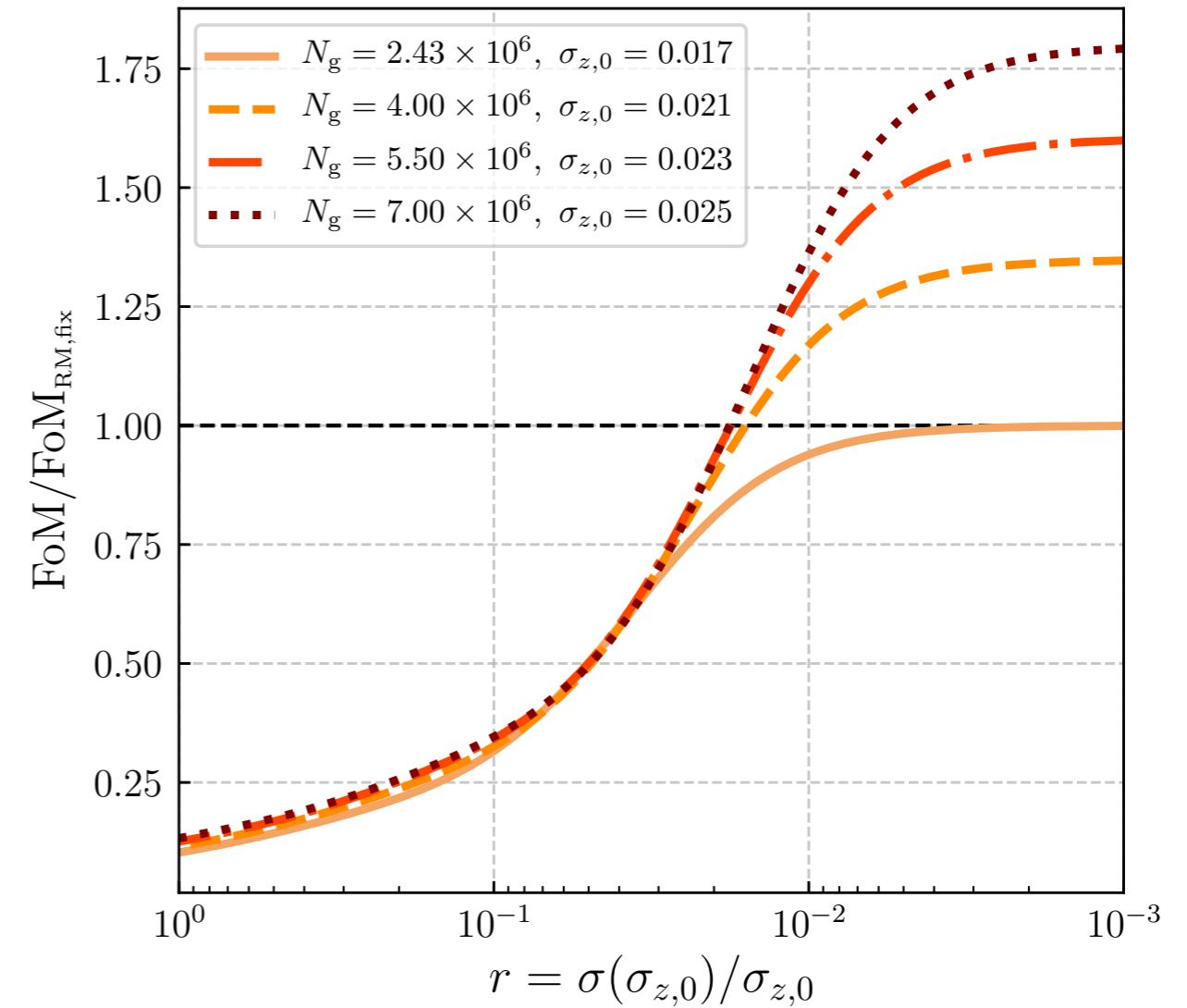
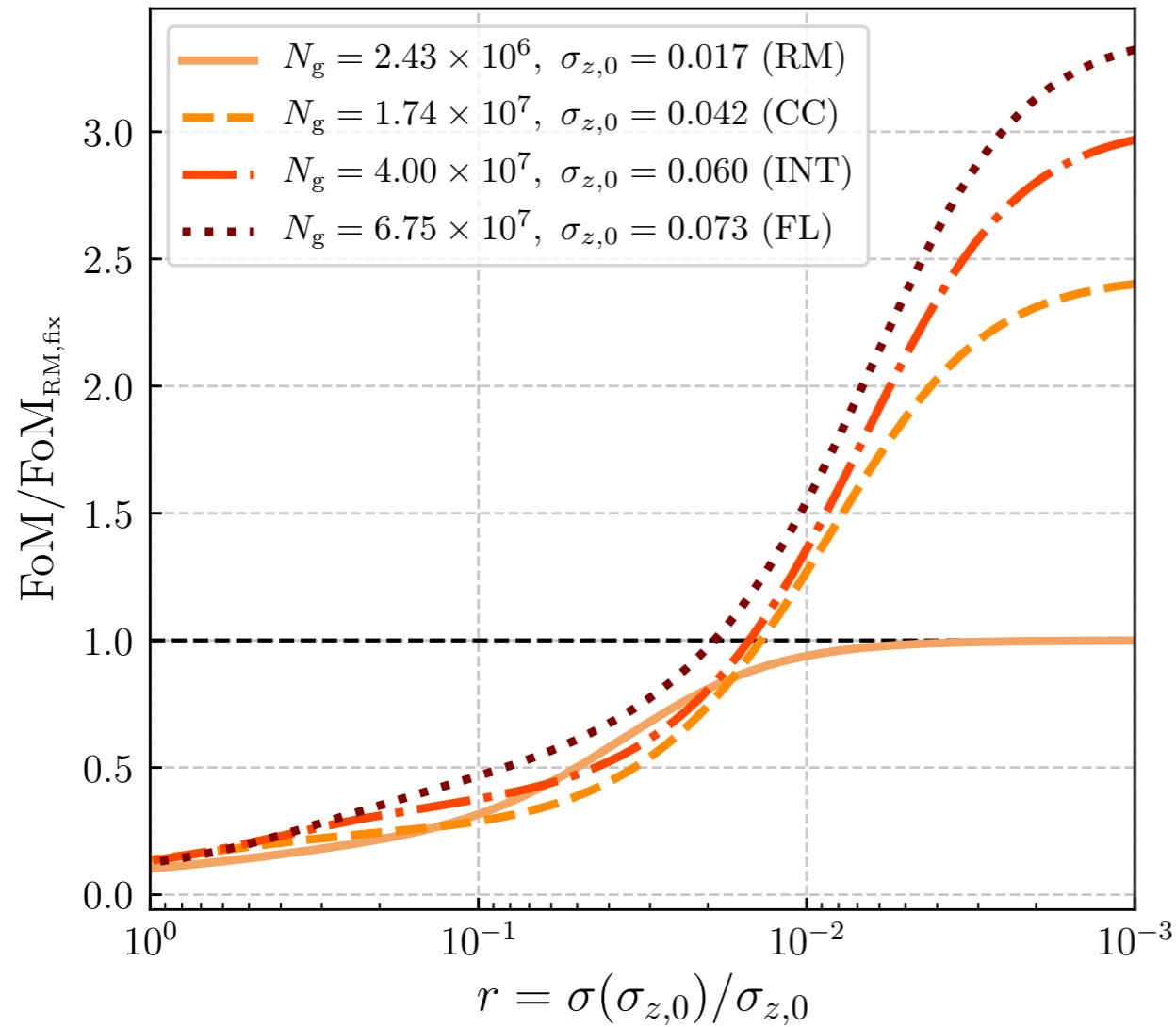
Thank you!

Backup slides

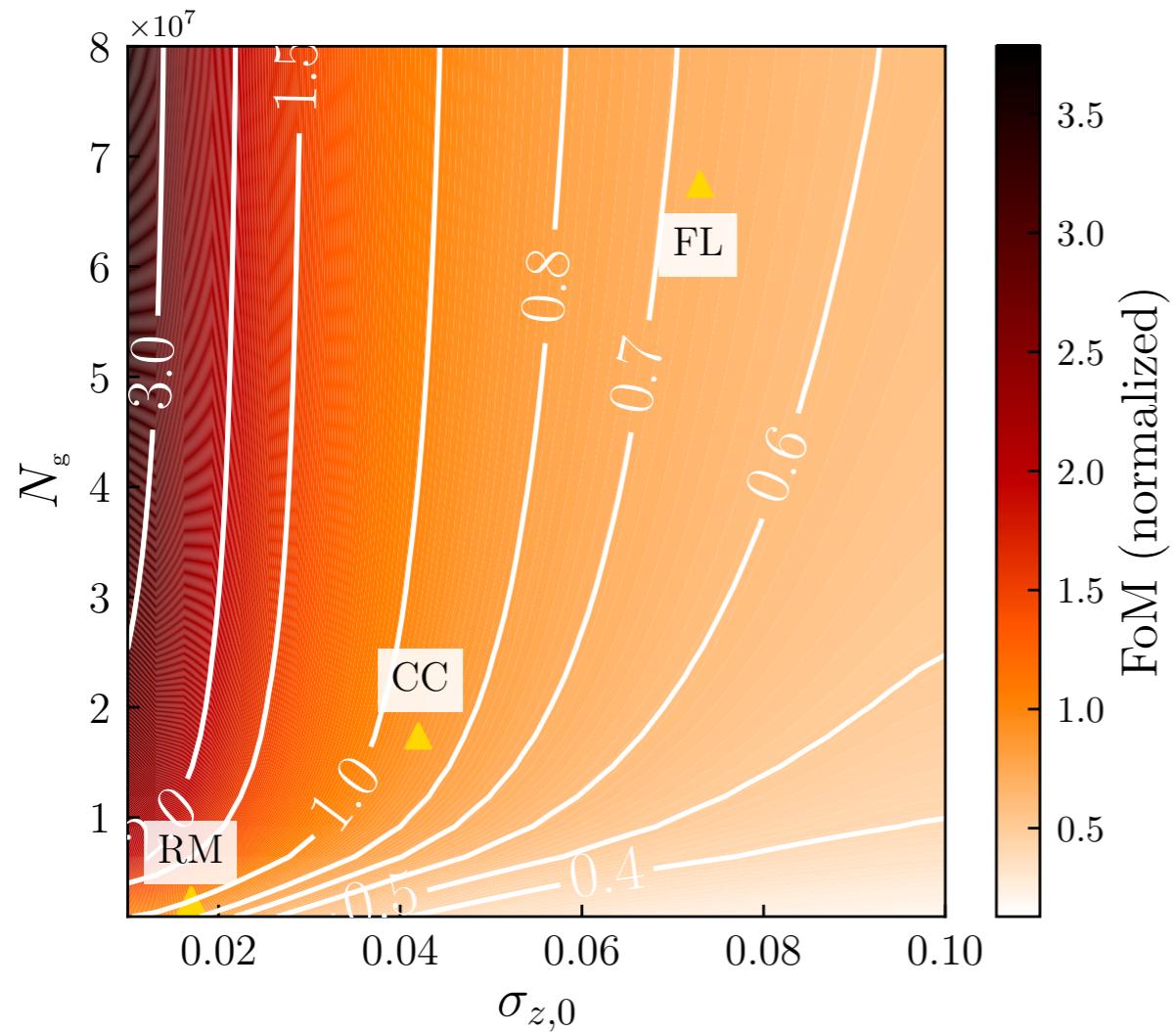
**why when cross correlations are included
FL gives better constraints?**



Dependence on priors

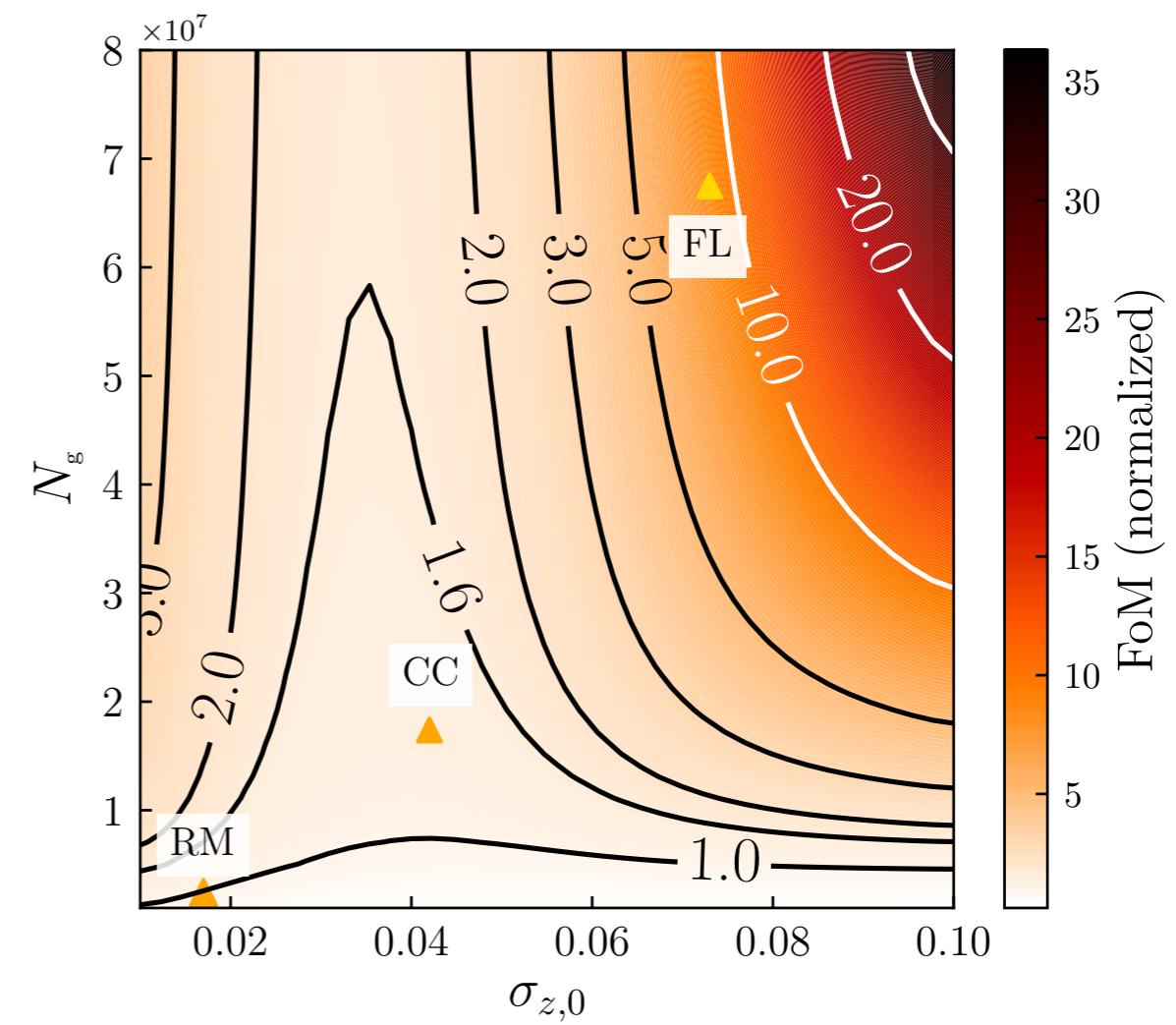


Results with fixed photo-z scatter



Conservative priors, auto-spectra only

Overall ~ 4.4 higher FoM



Conservative priors, auto- and cross-spectra