

Impact of systematics on cosmological parameters from future galaxy cluster surveys



ClustersXCosmo



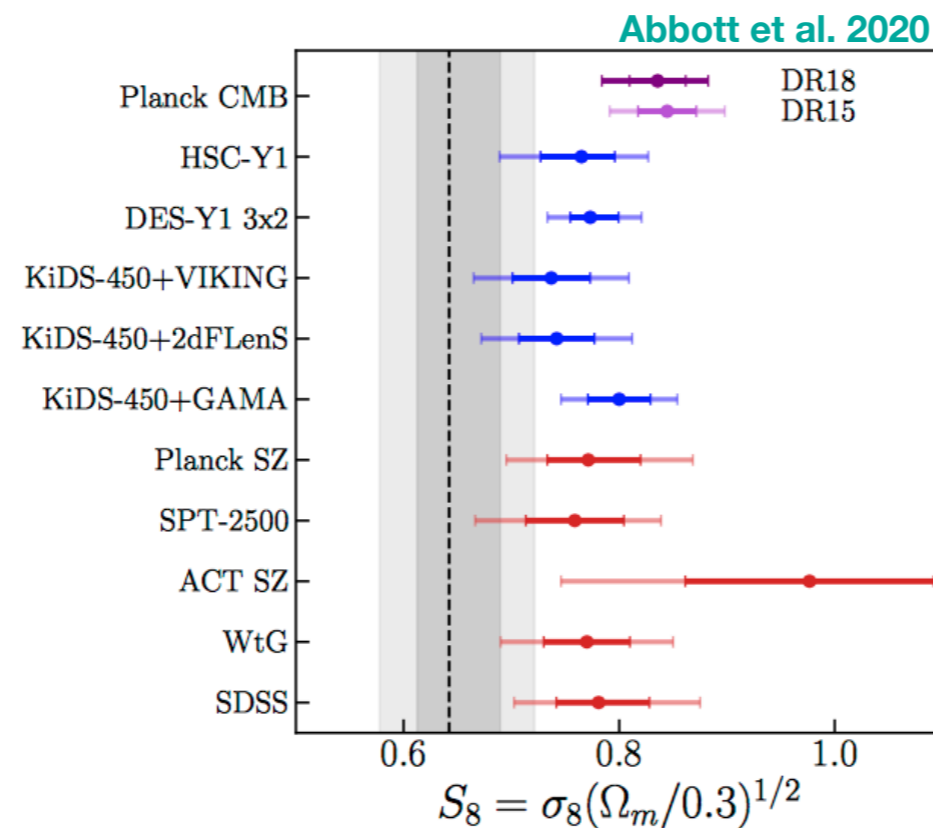
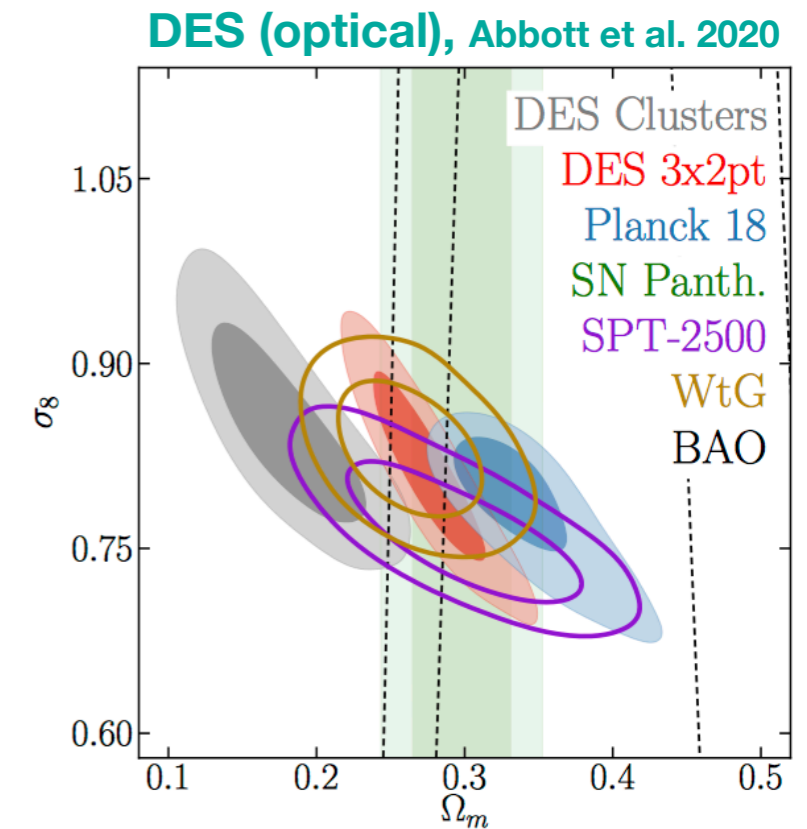
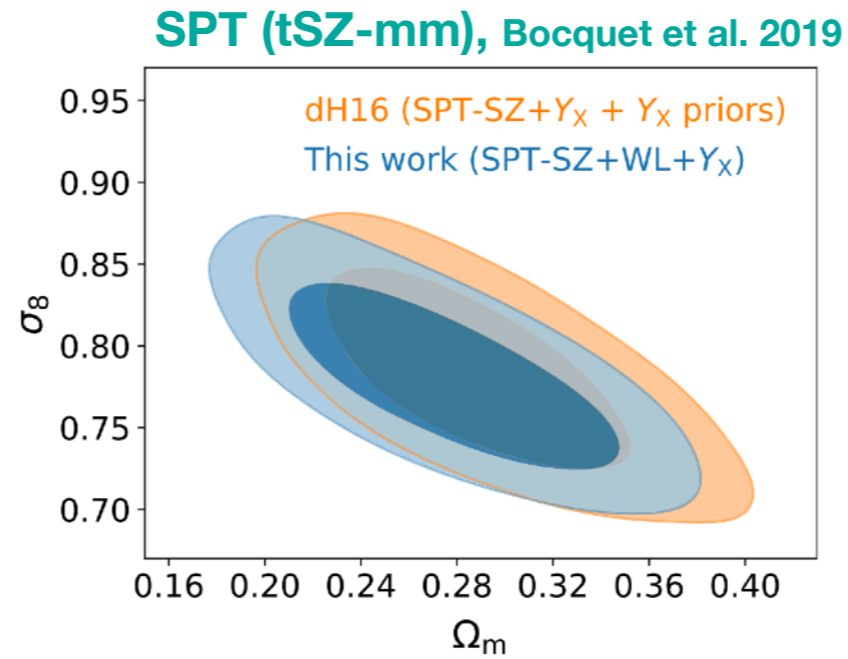
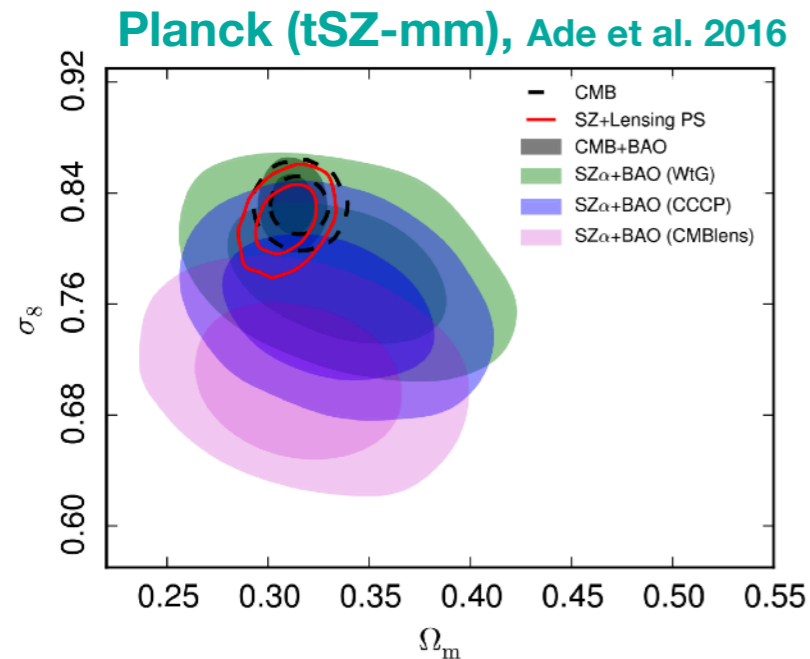
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in collaboration with
Marian Douspis and Nabila Aghanim



Results based on Salvati et al. arXiv:2005.10204v1

Cluster catalogs: ~ hundreds of objects \longrightarrow Mass Calibration: largest source of systematics

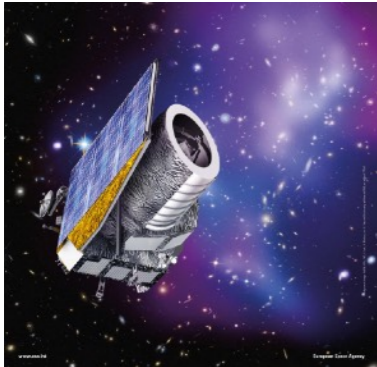


Future cluster surveys

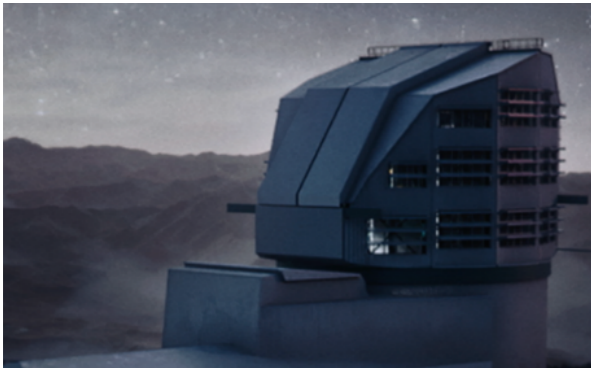
Future surveys: ~ thousands of clusters



Accuracy/precision on cosmological parameters:
dominated by systematic uncertainties



Euclid satellite



LSST -
Vera Rubin telescope



WFIRST -
Nancy Grace Roman space
telescope

**Impact on clusters cosmology of theoretical/
observational modelling for cluster
distribution:**

- **Precision and accuracy of Scaling Relation calibration**
- **Models and calibration of the Mass Function**

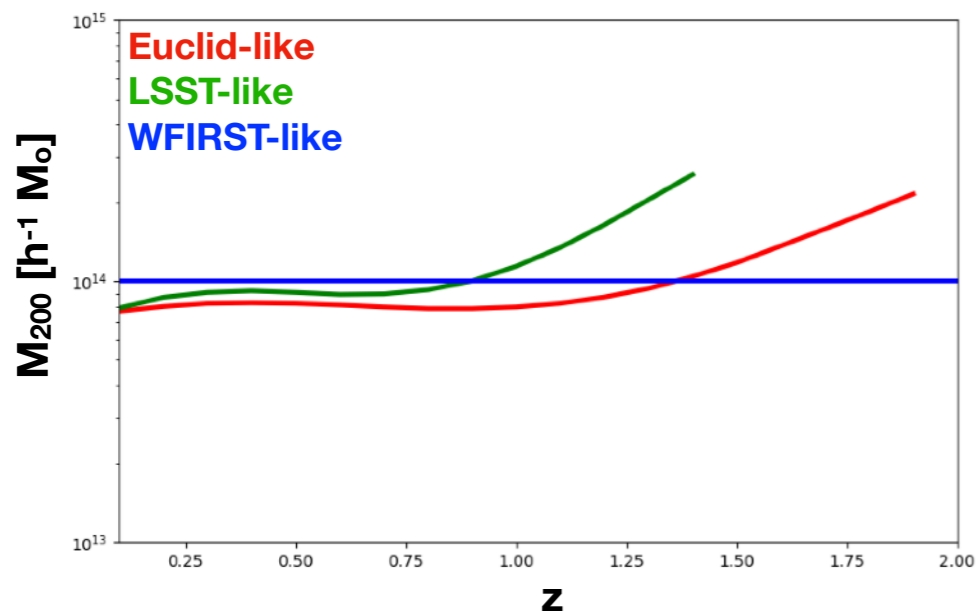
Method

Experiments

- **Euclid-like**
survey area: 15000 deg²
 $z = [0.1, 1.9]$
- **LSST-like**
survey area: 18000 deg²
 $z = [0.1, 1.4]$
- **WFIRST-like**
survey area: 2400 deg²
 $z = [0.1, 2.0]$

Ascaso et al. 2017
Gehrels et al. 2015
Sartoris et al. 2016

Selection Function



Scaling Relations

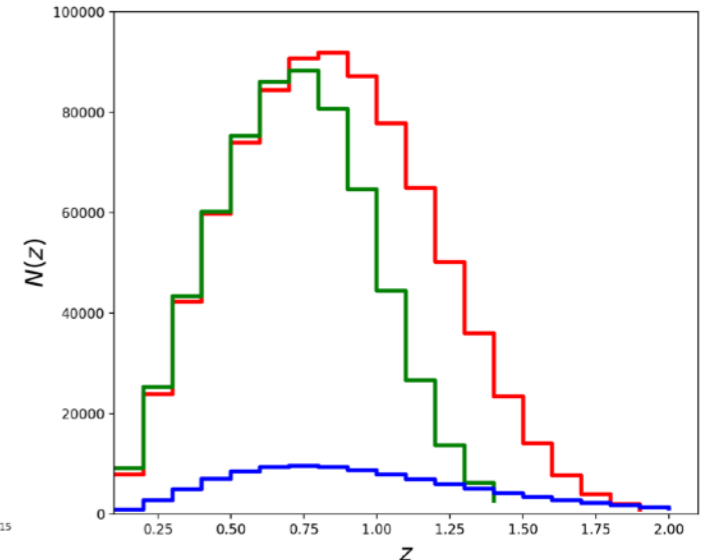
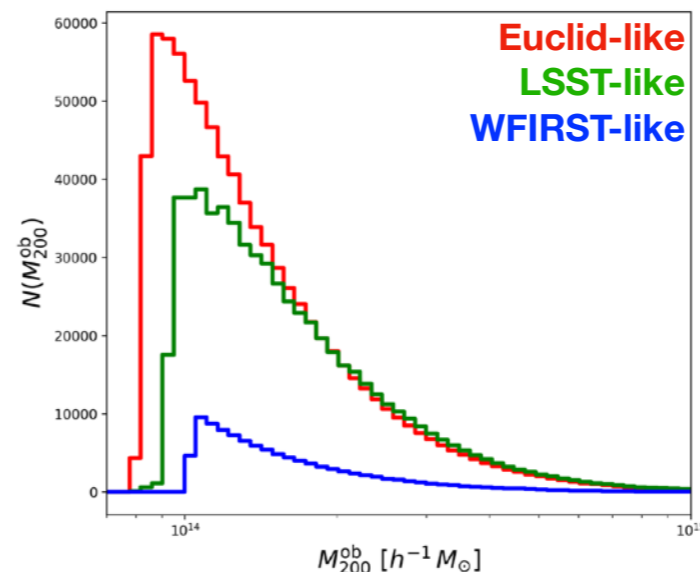
$$x(M_{200}^{\text{ob}}) = \frac{\ln M_{200}^{\text{ob}} - \ln M_{\text{bias}} - \ln M_{200}}{\sqrt{2\sigma_{\ln M_{200}}^2}}$$

$$\ln M_{\text{bias}}(z) = B_{M,0} + \alpha \ln(1+z)$$

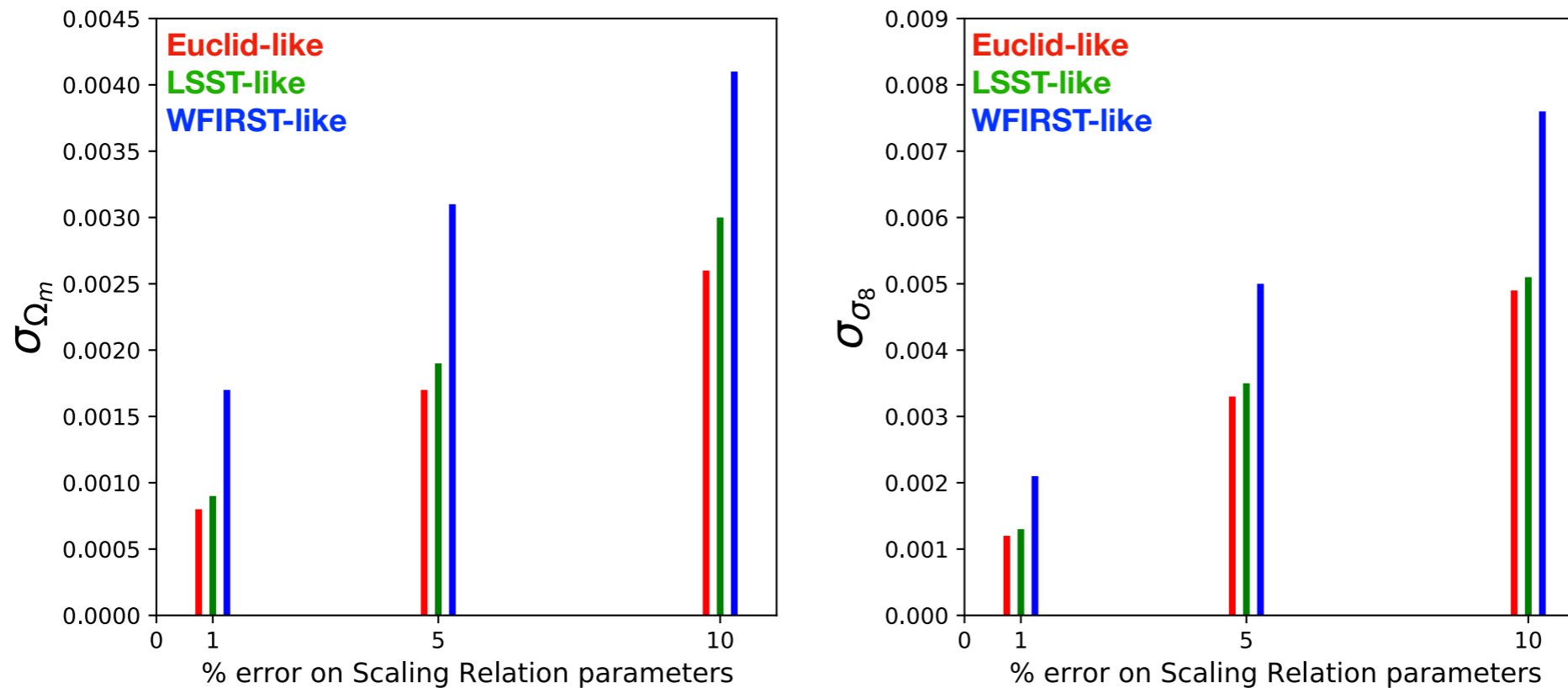
$$\sigma_{\ln M}^2(z) = \sigma_{\ln M,0}^2 - 1 + (1+z)^{2\beta}$$

Mass Function

- Tinker et al. 2008 (T08)
- Despali et al. 2016 (D16)



Impact of survey area and SR accuracy

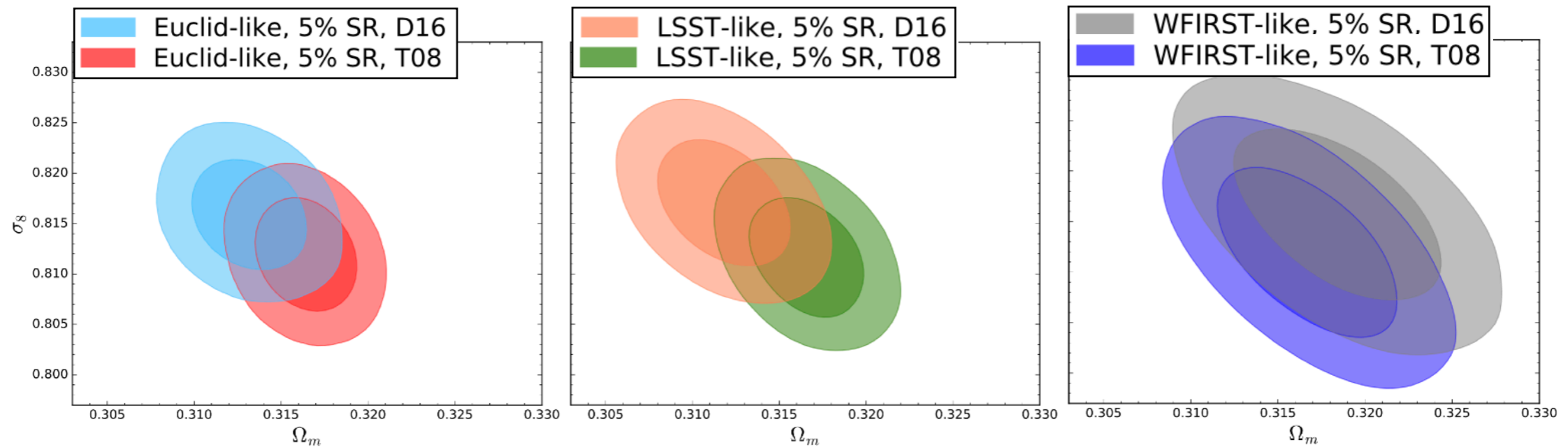


- Larger survey area: larger cluster sample
 - increasing accuracy on cosmological parameters
- More accurate calibration for SR
 - increasing accuracy on cosmological parameters

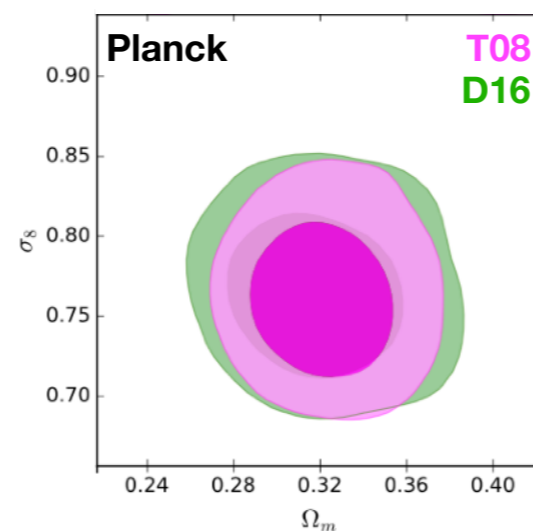
Planck results:

$$\sigma_{\sigma_8} = 0.03, \quad \sigma_{\Omega_m} = 0.03$$

Impact of Mass Function



Increasing precision and accuracy on cosmological constraints
Choice of the Mass Function: NON-NEGLIGIBLE source of systematic uncertainty



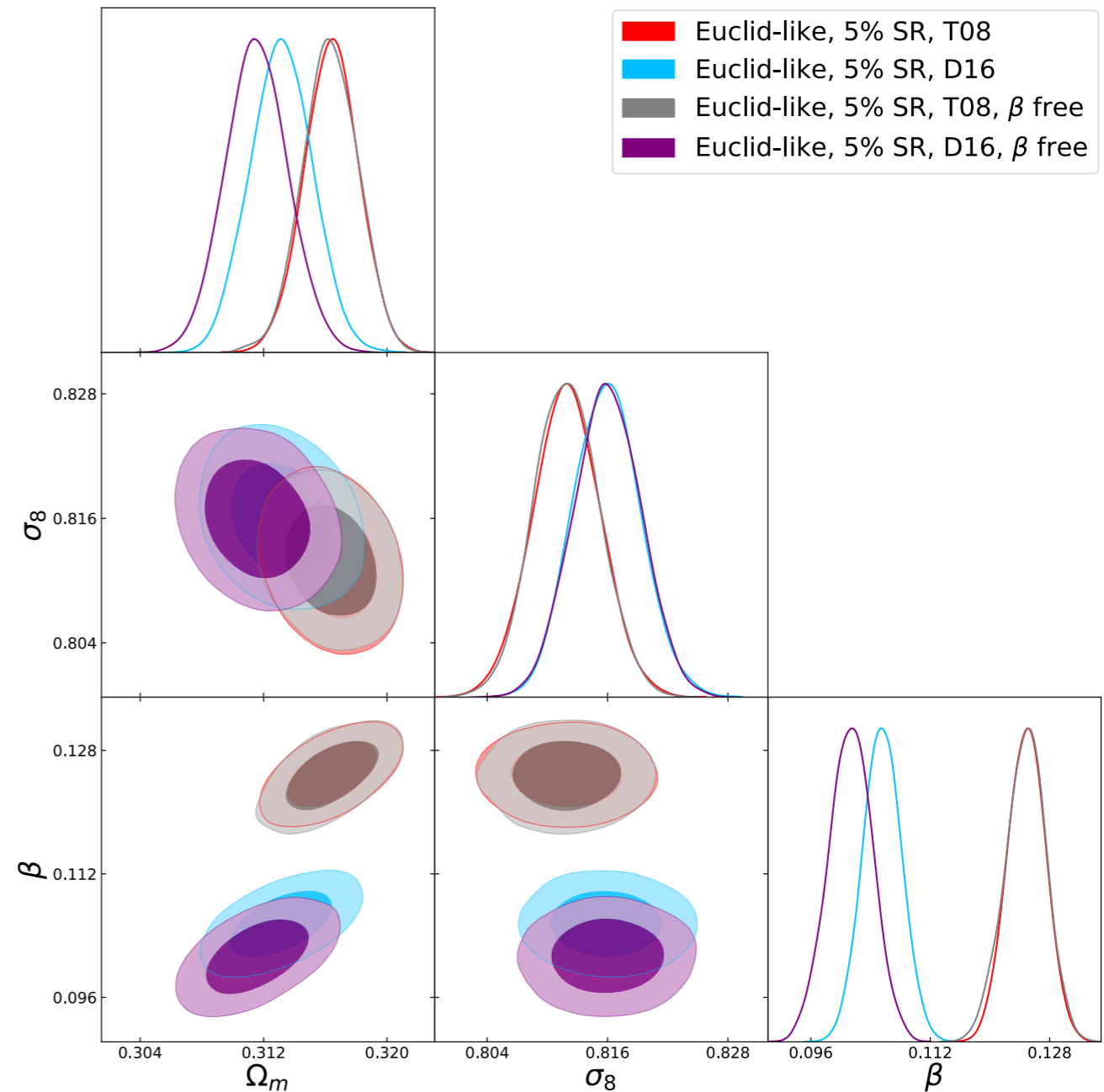
Impact of Mass Function

Evidence for different z-evolution for T08 and D16

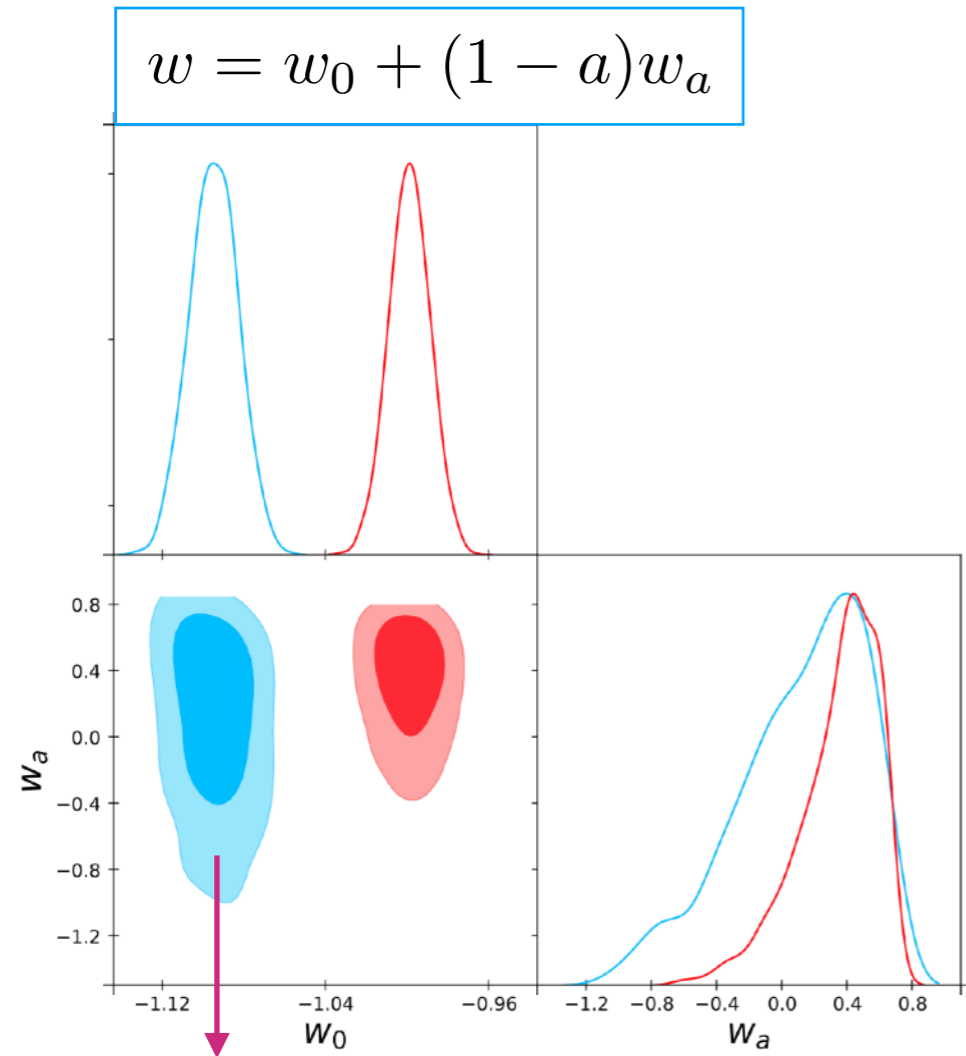
D16 vs T08

- Consistent in the intermediate mass range
- D16 predicts more clusters at high z
- Compensating for different z-evolution

$$\beta_{\text{D16}} < \beta_{\text{T08}}$$

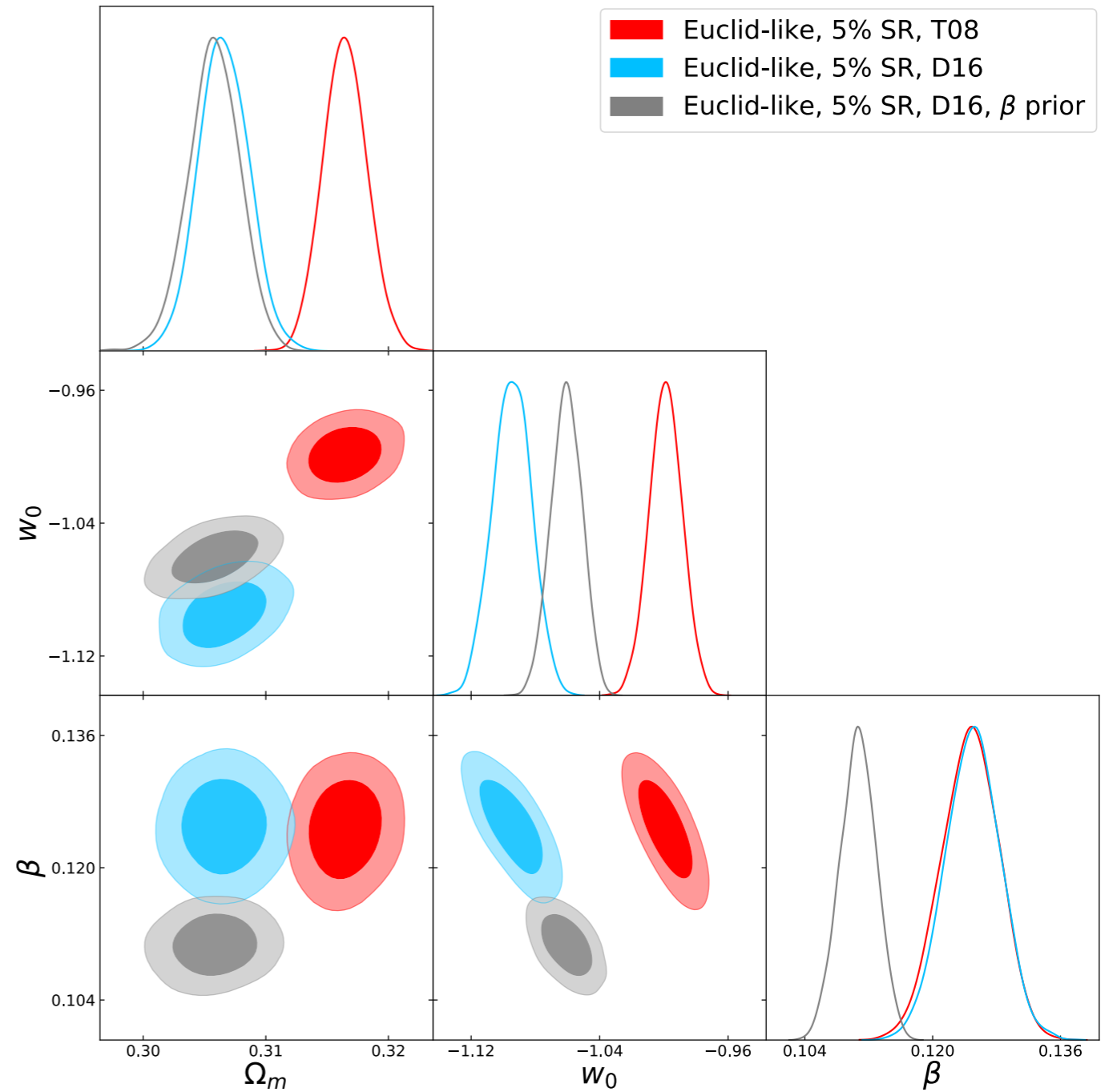


Impact of Mass Function



$\sim 8\sigma$ inconsistent with $w_0 = -1$

Evidence for different z-evolution for T08 and D16



Conclusions

Largest cluster samples + expected increased accuracy in SR calibration

- Expose impact of “new” sources of systematic uncertainties

Mass Function from numerical simulations

- simulation resolution
- initial conditions
- cluster definition and detection
- modelling of z-evolution and universality

Not accounting for impact of selection function

- tightly related to experiment characteristics and detection approach