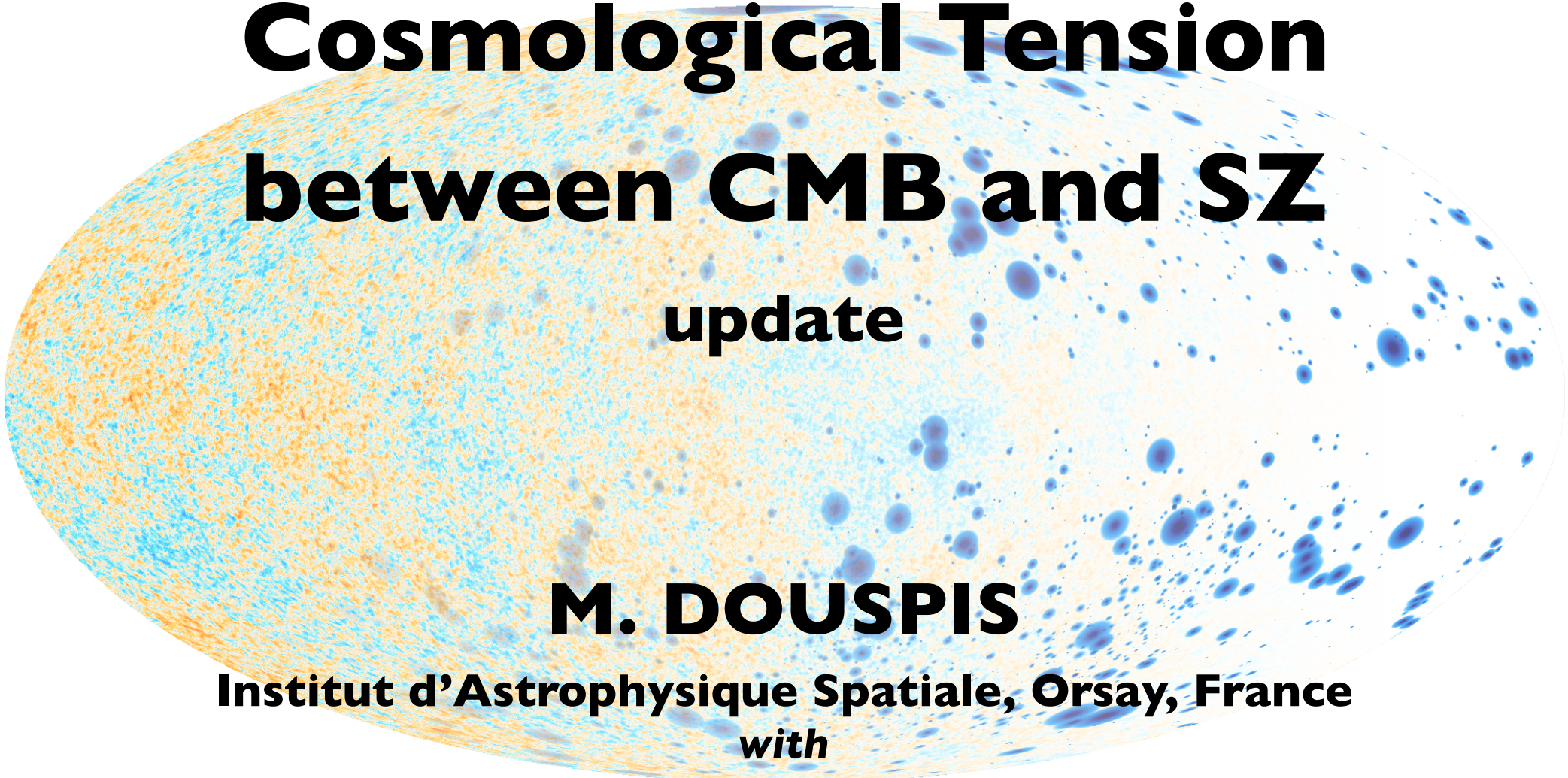
Colloque national DARK ENERGY
11-13 octobre 2017 LAL-Orsay, France

erc ByoPiC

# Cosmological Tension between CMB and SZ

## update



**M. DOUSPIS**

**Institut d'Astrophysique Spatiale, Orsay, France**

***with***

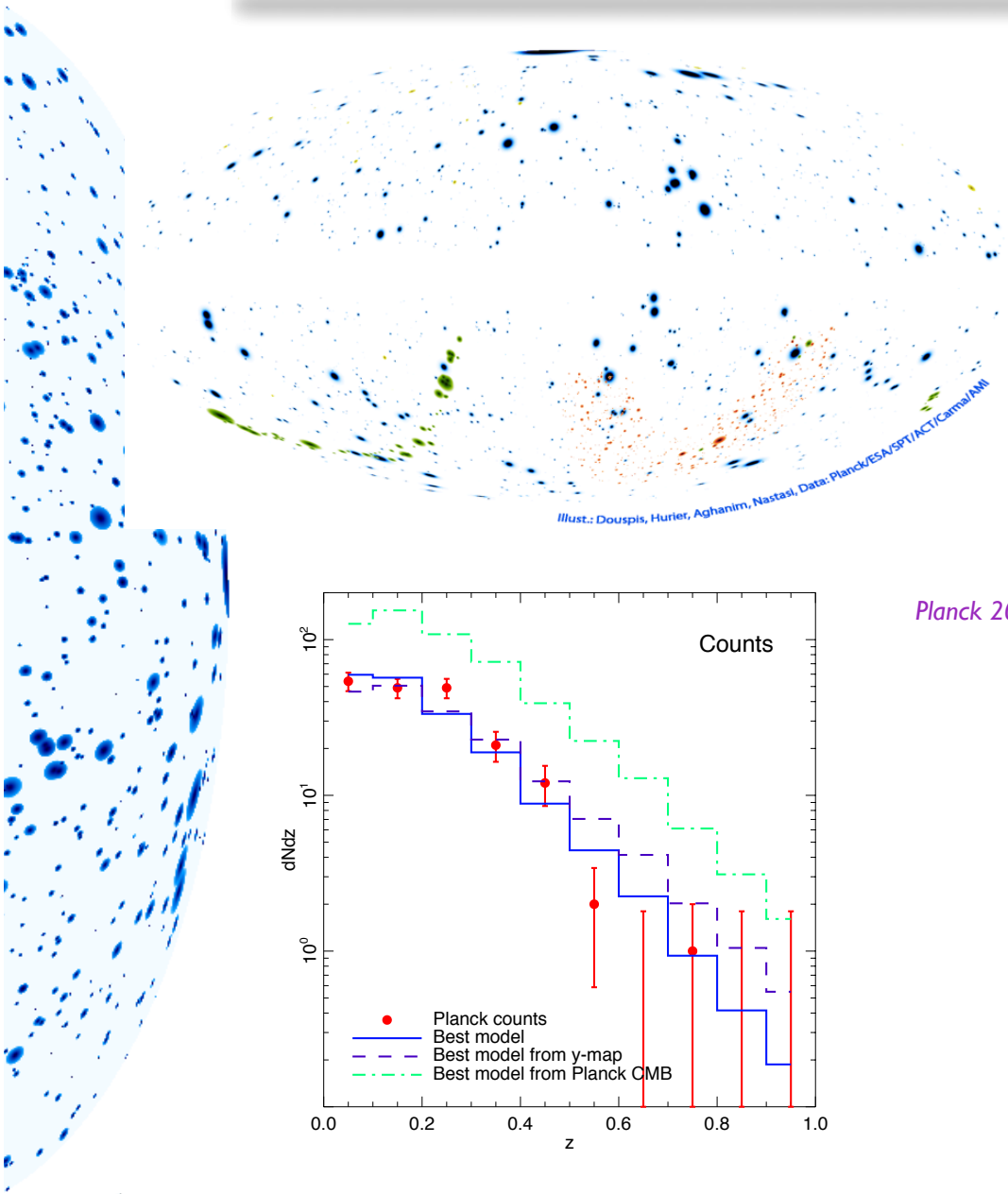
**S. Ilic, G. Hurier, F. Lacasa, L. Salvati**

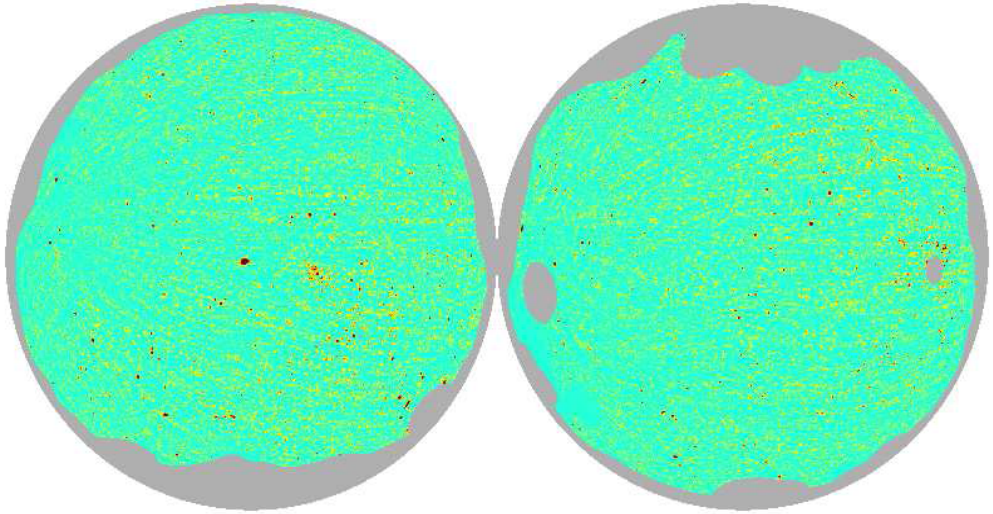
**N. Aghanim**

IAS Orsay

*A&A 582, A79 (2015)* *A&A. 576, A90 (2015)* *A&A 604 A71 (2017)* *arXiv:1708.00697*

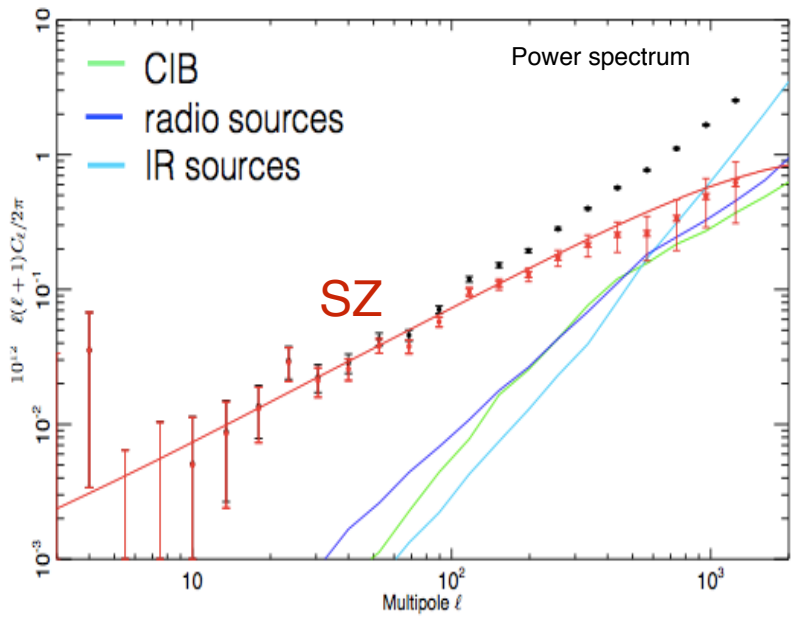
# SZ signal in Planck





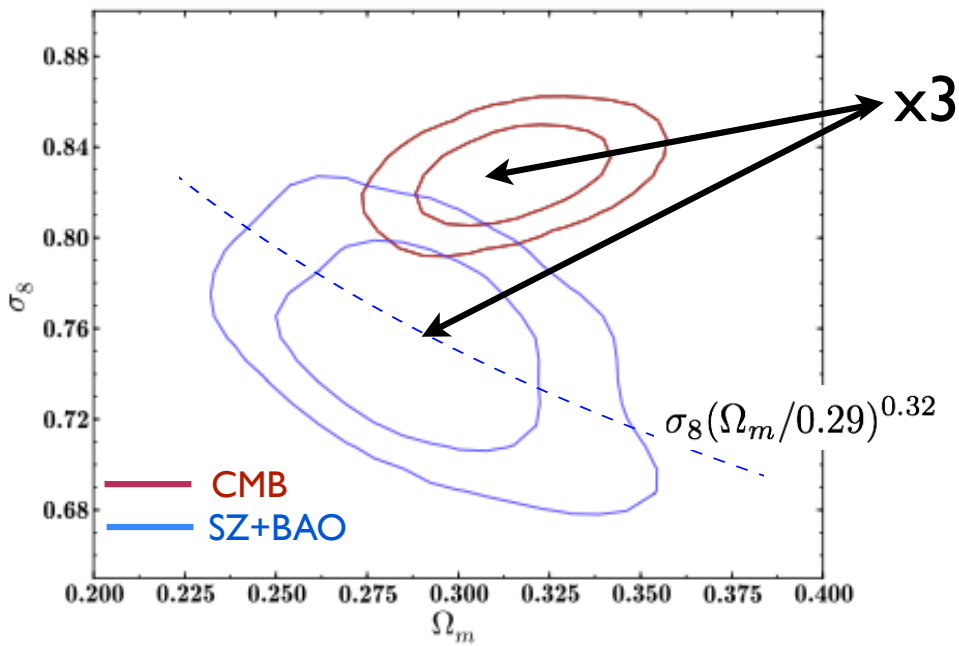

*Planck 2013, 2015*



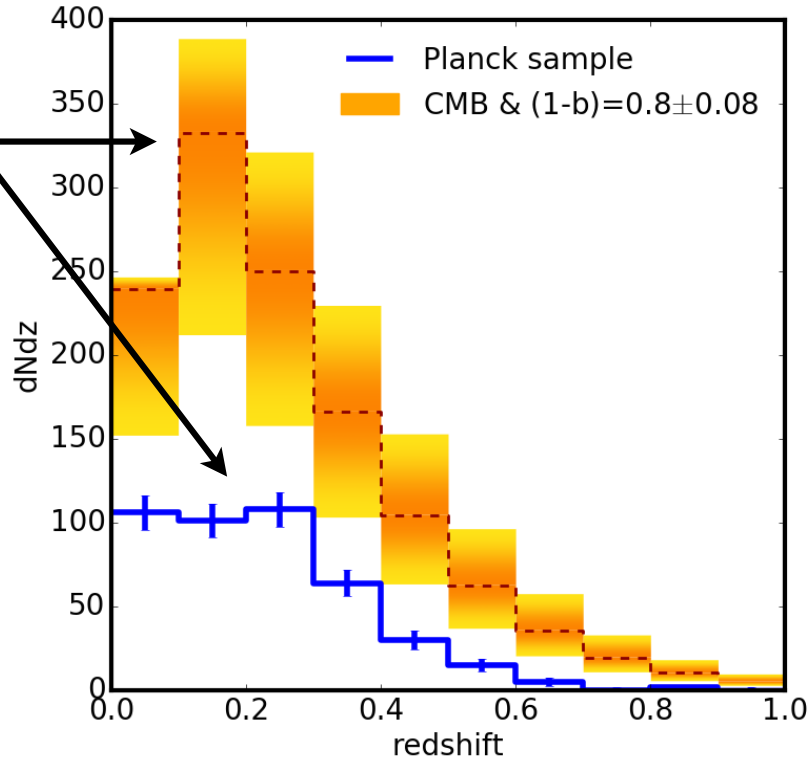
# SZ cosmology

$$\frac{dN}{dz} = \int d\Omega \int dM_{500}\, \hat{\chi}(z, M_{500}, l, b)\, \frac{dN}{dz\, dM_{500}\, d\Omega}$$

Planck 2014 XX showed:




x3

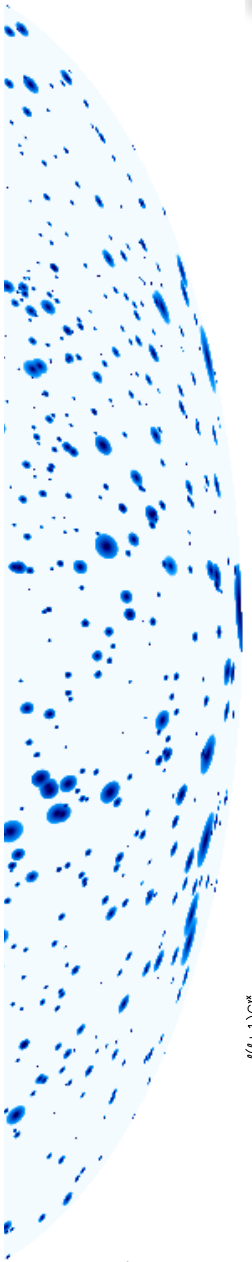


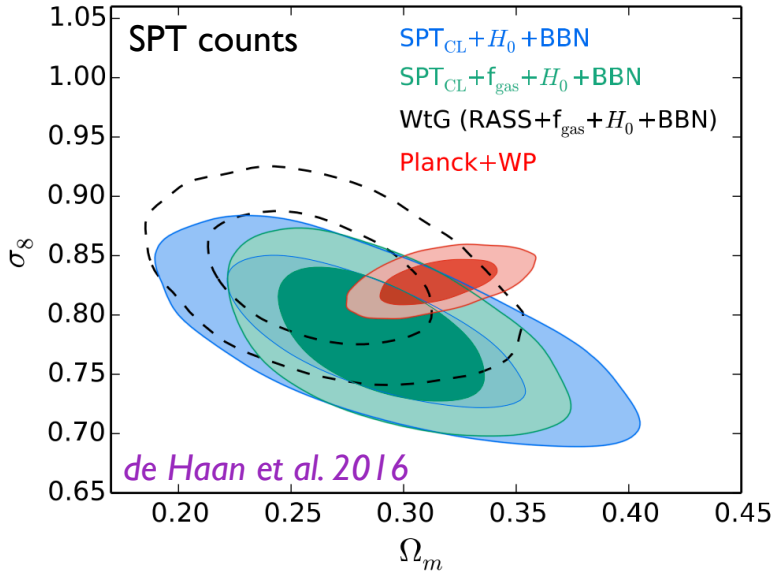

*idem : Planck 2015 XXIV*

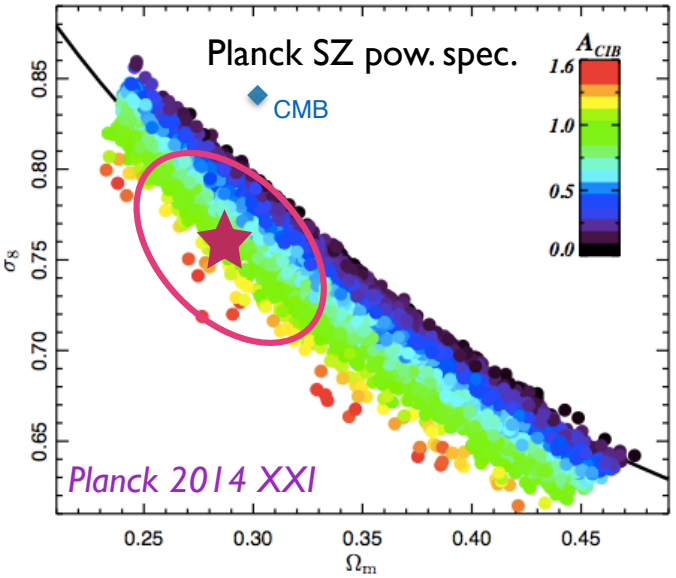
*Salvati, Douspis, Aghanim (2017)*

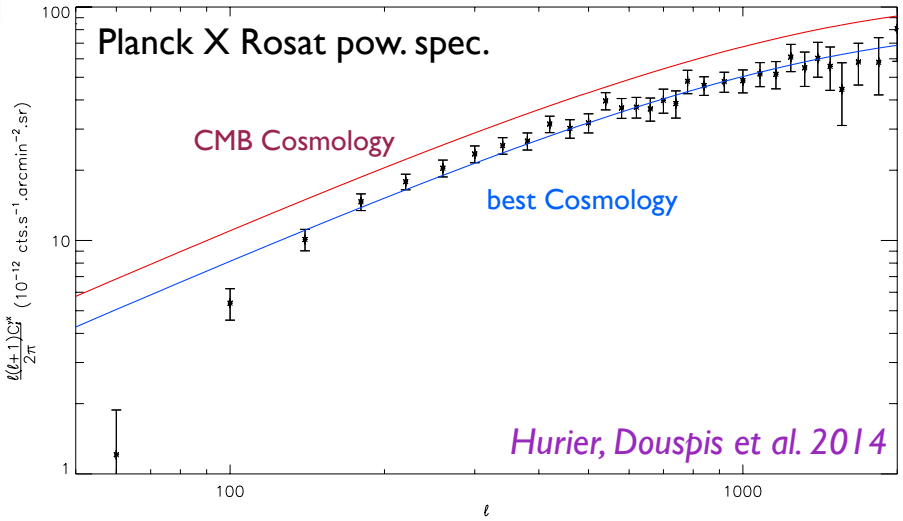
Planck SZ Tension !

# Are Planck SZ counts wrong?





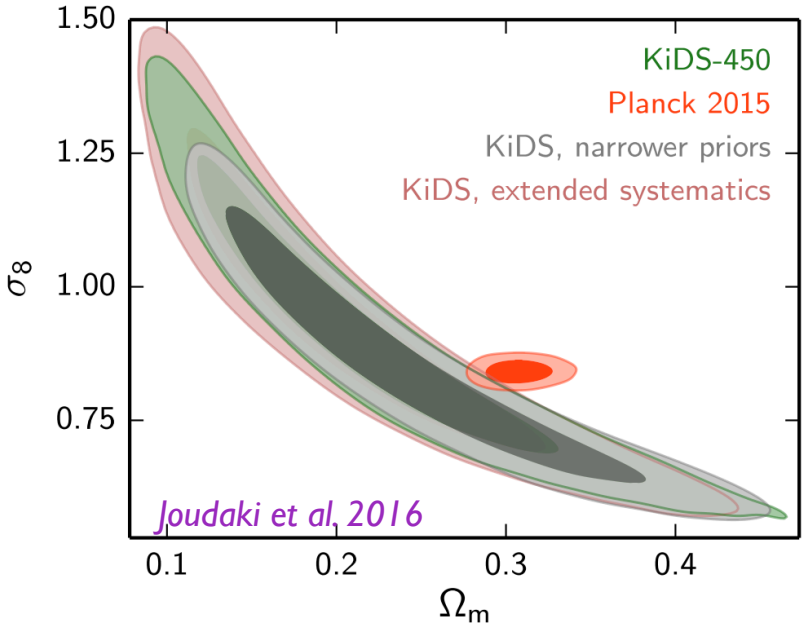



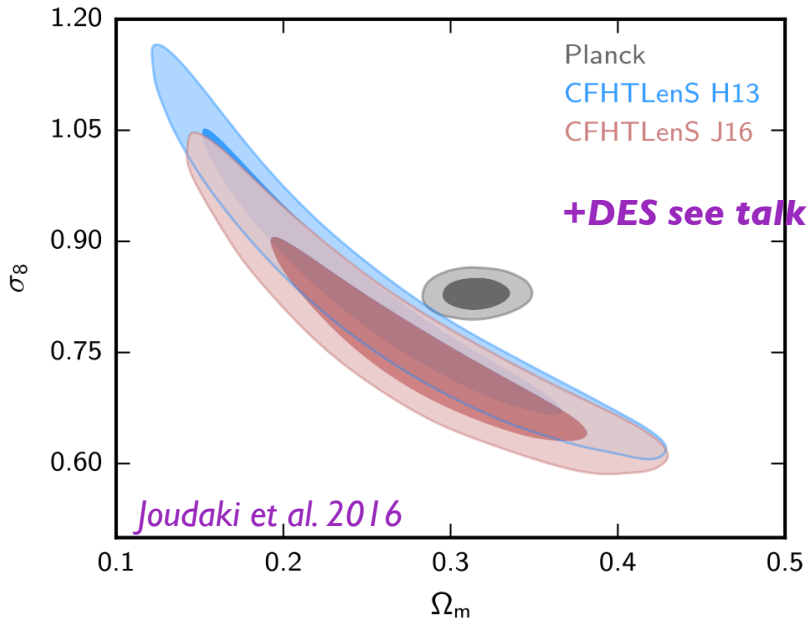

- 1-PDF *Planck 2014 XXI*
  - PLCK: $\sigma_8 = 0.779 \pm 0.02$
  - ACT: $\sigma_8 = 0.793 \pm 0.04$ *Colin Hill, 2014*
- Bispectrum *Hurier & Lacasa, 2017*
  - PLCK: $\sigma_8 = 0.74 \pm 0.04$
  - SPT: $\sigma_8 = 0.787 \pm 0.03$ *Crawford, 2014*

Agreement with other cluster and SZ studies

# Is SZ wrong ?

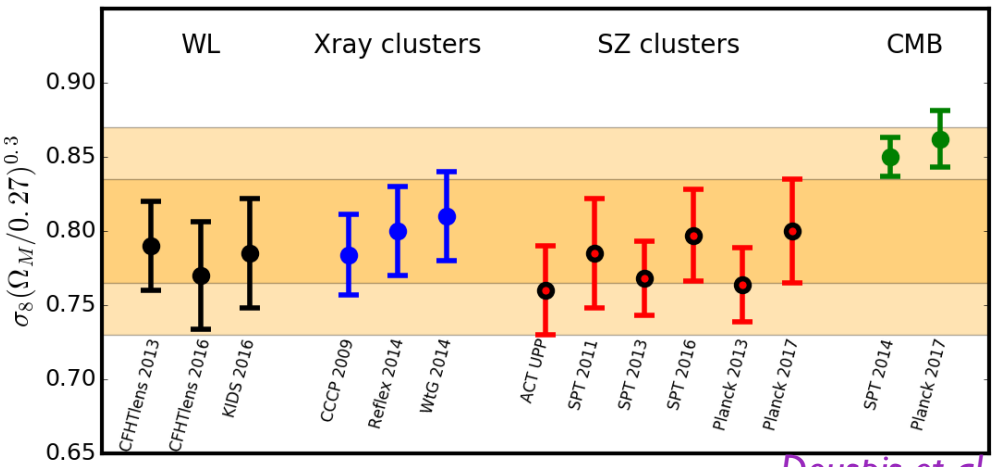
## Cosmic shear tomography measurements




**Consistency with Xray clusters**

- local sample — *Ilic et al. 2015*
- high mass sample — *Boehringer et al. 2016*




*Douspis et al.*

## Consistency of SZ with other analyses

# tricky ingredient: the Mass

- Masses obtained from scaling relations+HMB

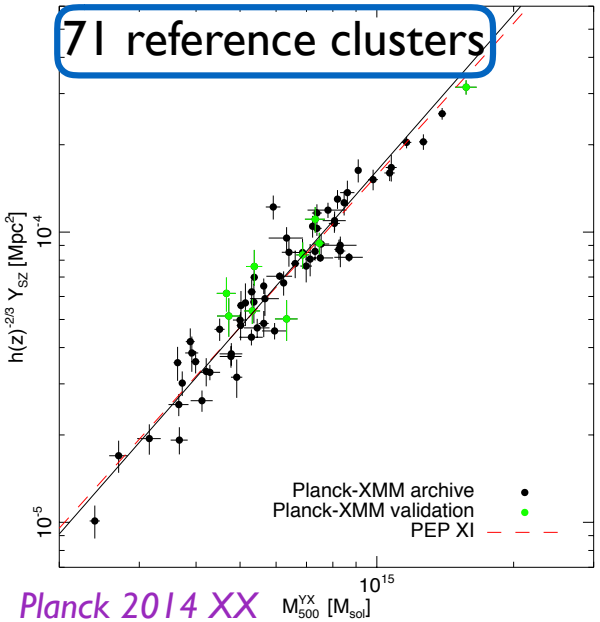
$$E^{-\beta}(z)\left[\frac{D_A^2(z)\,\bar{Y}_{500}}{10^{-4}\,\mathrm{Mpc}^2}\right] = Y_*\left[\frac{h}{0.7}\right]^{-2+\alpha}\left[\frac{(1-b)\,M_{500}}{6\times10^{14}\,\mathrm{M_{sol}}}\right]^{\alpha}$$

$$M_{500}^{YX} = (1-b)\,M_{true}$$

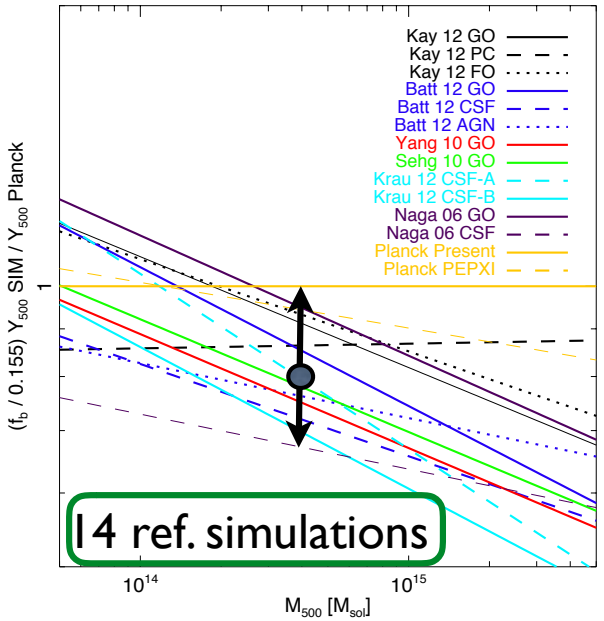
- Our study converges towards

$$(1-b) = 0.8\ in\ [0.7-1.0]$$

Degeneracy cosmology/bias:
need (1-b)~0.6 for CMB cosmology

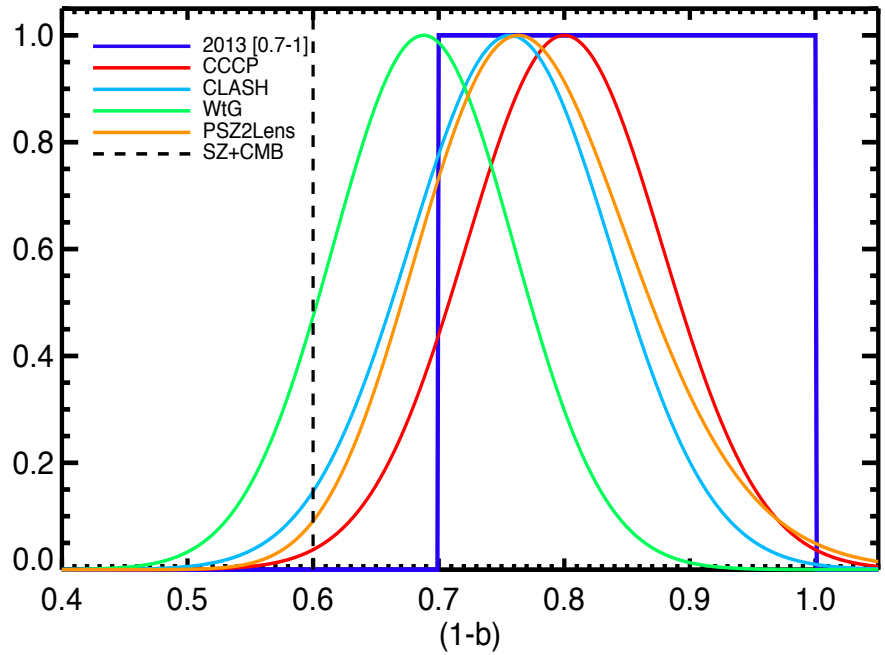


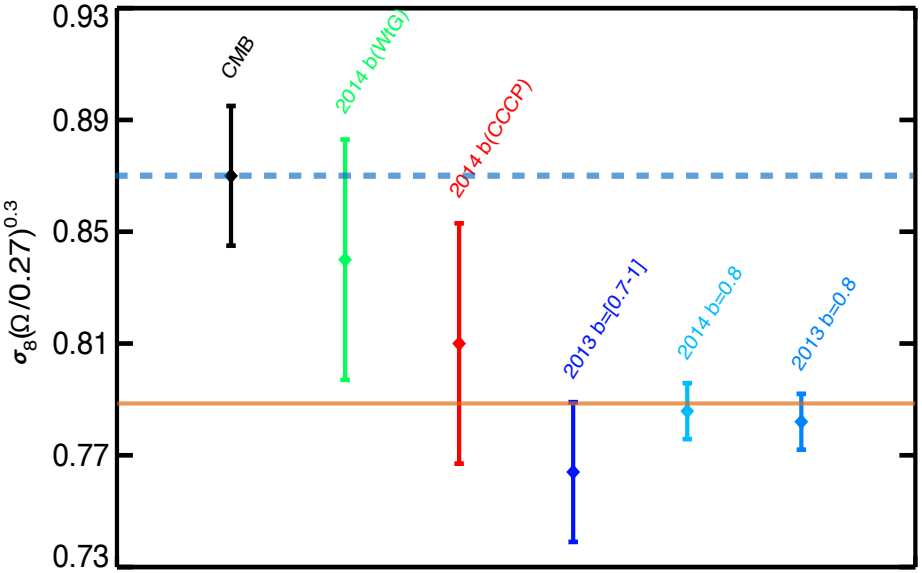

*Planck 2014 XX*



# non SZ/X information?

- Weak Lensing for the mass estimation:
  - ➡ traces directly the total mass (for a few clusters)
  - ➡ recalibrate your masses: $Y_{SZ} \propto M^{YX} = (1-b)M_{WL}$

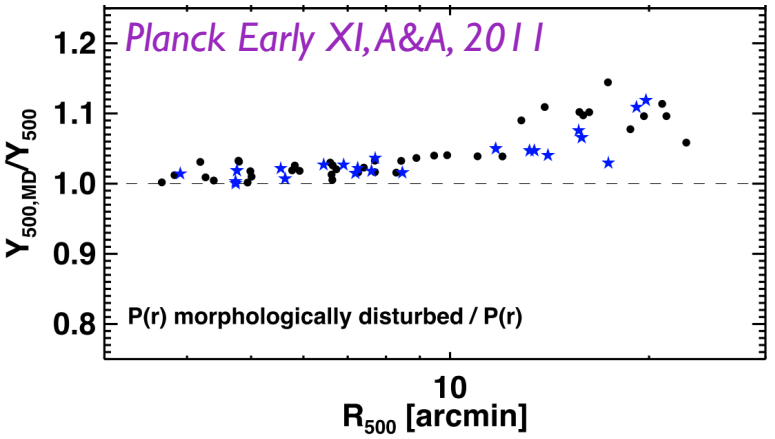


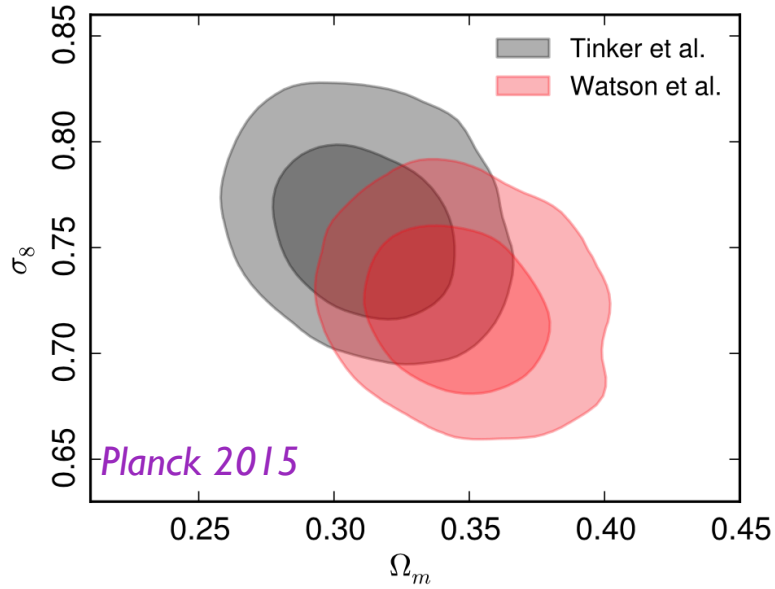




- ➡ Several studies on small not necessarily representative samples
- ➡ 10% cluster by cluster
- ➡ needs better/larger samples and lower systematics

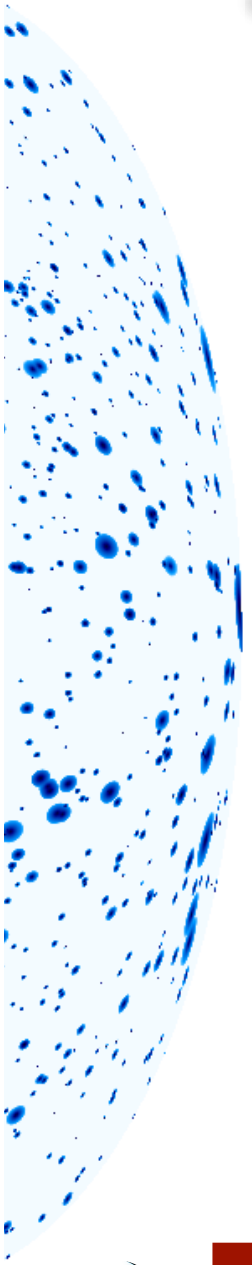
# Other systematics

- Less numerous cool core in SZ
  - need different profile <10%
- XMM/Chandra calibration
  - ~10% effect on scalings
    *eg. Israel 2015*
- Mass function uncertainty
  - ~10% scatter, baryonic effects ? *eg. Martizzi 2013*
- Evolution of scaling/bias
  - with z, with Mass ?
- Non thermal gaz motion
  *eg. Nagai et al. 2016*



# Updates since 2014



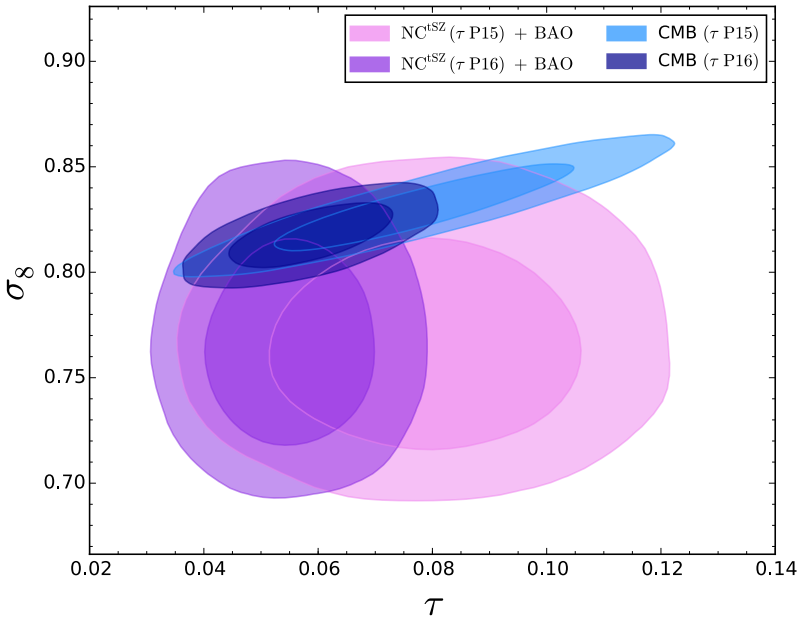
- Clusters
  - PSZ2Lens bias estimation on 29 SZ clusters in CFHT confirms (1-b)=0.8 from sims *(Sereno et al. 2017)*
  - 189 → 400 clusters *Planck 2016*
  - Combination SZ Counts + SZ spectrum *Salvati, Douspis, Aghanim (2017)*

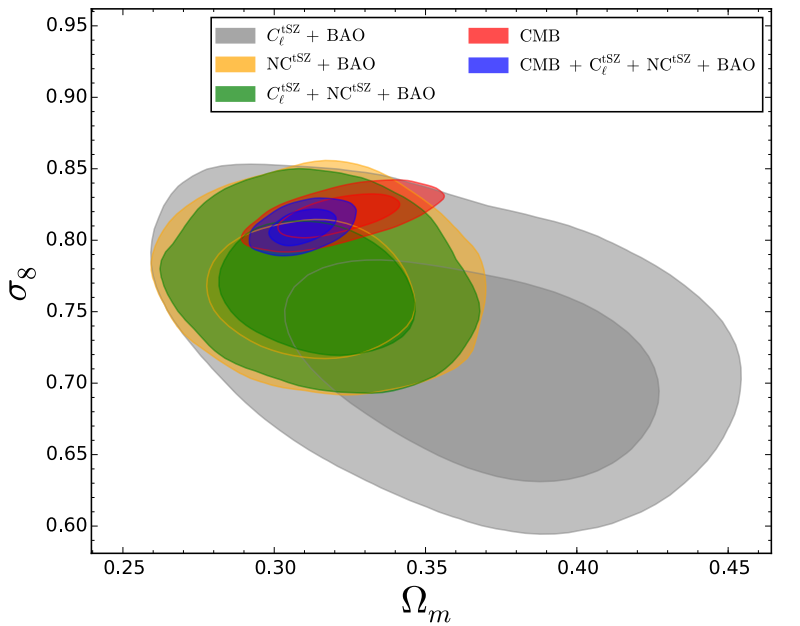
➡ Same constraints

- CMB
  - New estimation of reionisation optical depth: $\tau \sim 0.06$ *Planck XLVII 2016*

➡ Lower sigma8

➡ tension in LCDM reduced to 1.5 σ

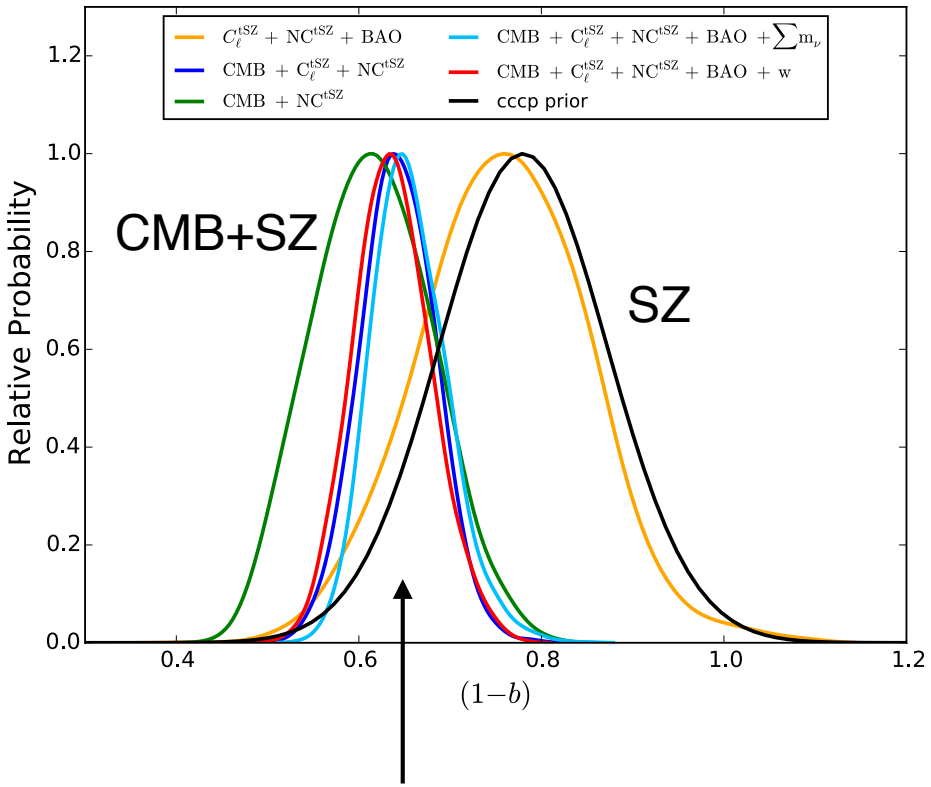


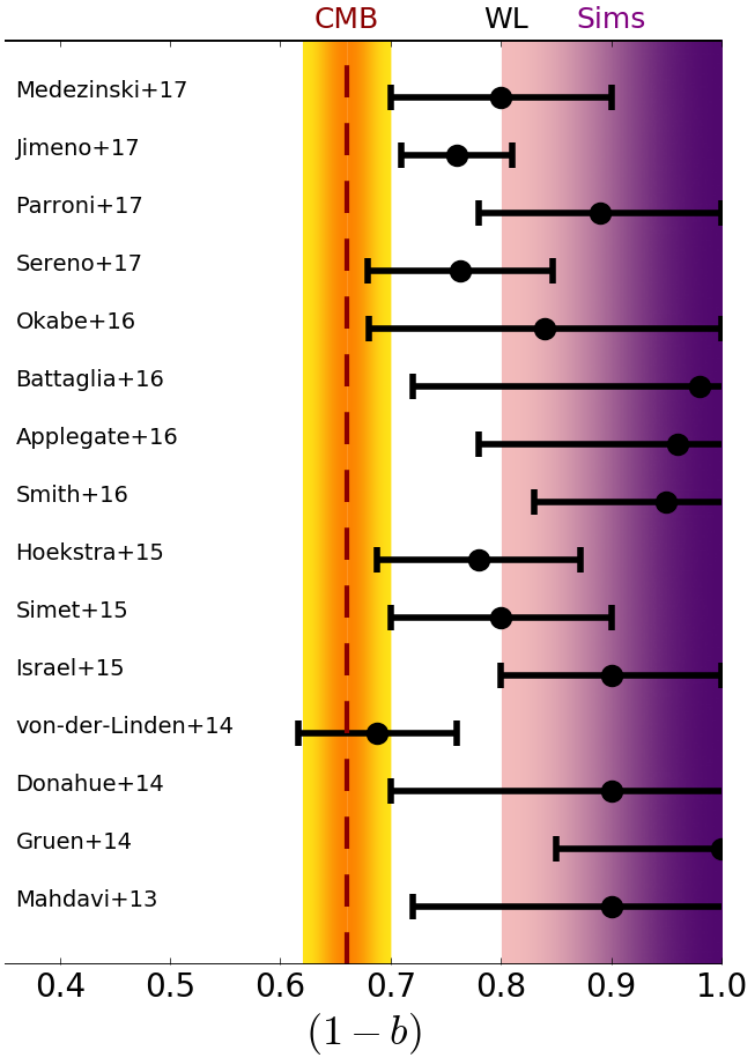

*Salvati, Douspis, Aghanim (2017)*

# Update since 2014

➡ tension in LCDM reduced to 1.5 σ but




$(1\text{-}b)_{CMB+SZ} < 0.66$

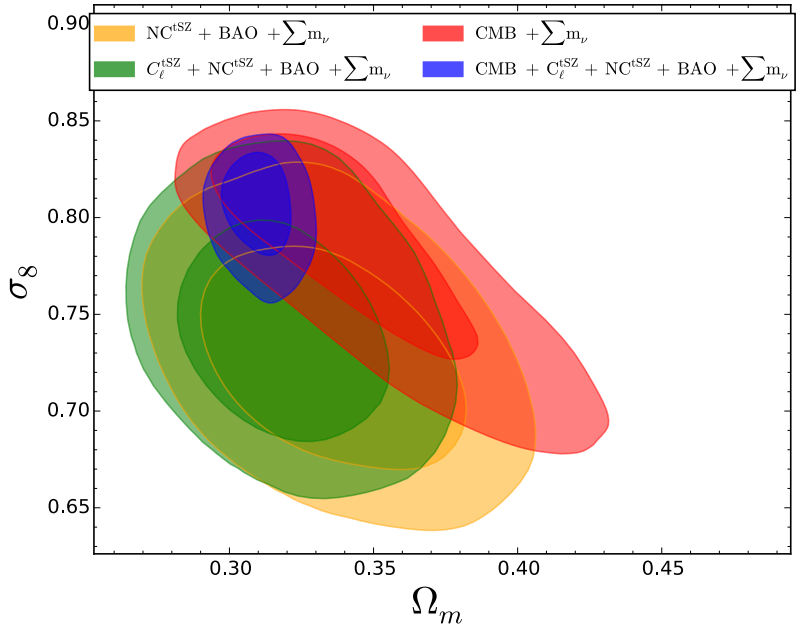


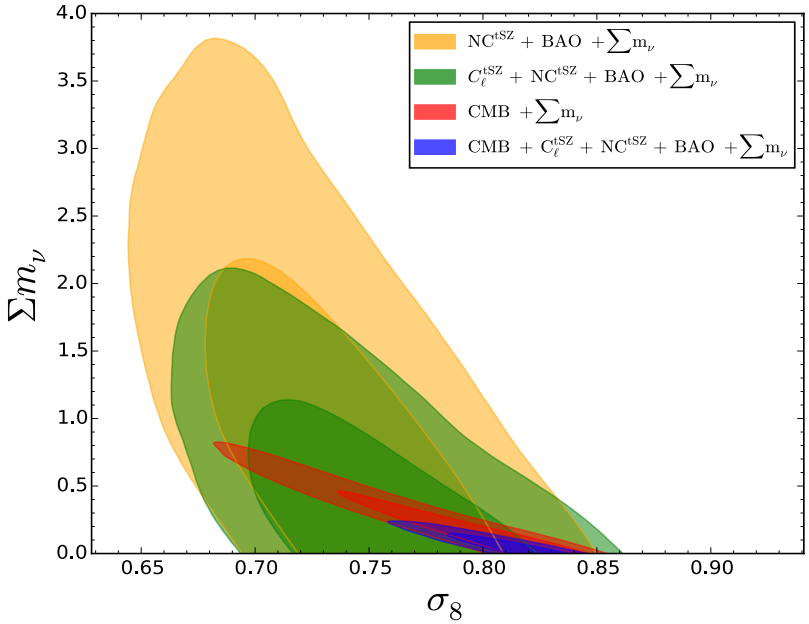

*Salvati, Douspis, Aghanim (2017)*

# Cosmological model extensions

- Massive neutrinos
  - Reduces tension 1.2 σ
  - sum(mnu) < 0.19 eV

*Salvati, Douspis, Aghanim (2017)*



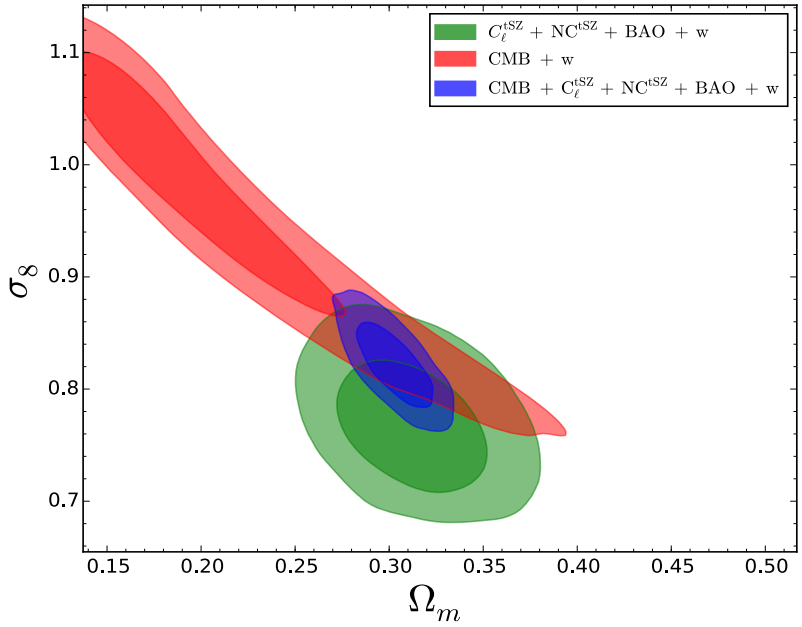



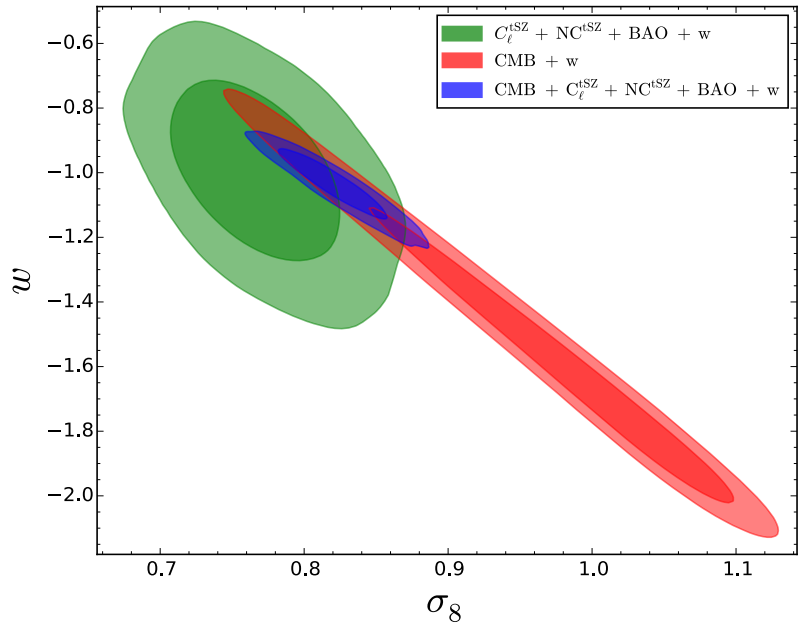
# Cosmological model extensions

- Massive neutrinos
  - Reduces tension 1.2 σ
  - sum(mnu) < 0.19 eV
- Non-lambda Dark energy
  - Clusters break degeneracies but LCDM preferred
- Modified GR
  - ???

*Salvati in prep, Blanchard in prep*

➡ Non trivial extensions



# Conclusions & Perspectives

- Cosmology from SZ selected clusters limited by systematics (same for other wavelength)
  - Hydrostatic Mass bias
    - sims: b < 20%
    - WL: (1-b) in [0.7 - 1]
  - From Cluster point of view
    - work to know HMB
    - work to estimate WL mass
    - large representative sample
  - From Cosmo
    - Find good extension of standard model
- Tension with *Planck* CMB