SZ power spectrum from self-consistent X-ray analysis

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17/02/2012 - Planck 2012 Conference

Outline

- X-ray results
- Modelling of SZ contribution
- Results on SZ power spectrum
- Conclusion

X-ray results

Motivation

Population very sensitive to the mass & growth factor

→ Modeling by mass function (Press & Schechter 1974)

→ Dependent of the cosmology (Ω_m,σ_8...)

$$N(M) = \frac{\rho}{M} f(\nu) \frac{d\sigma}{dM}$$

Need mass → $M_v = \frac{4\pi}{3} R_v^3 \Delta\bar{\rho}$

X-ray results

The temperature function

- From the mass function

$$N(> k_B T) = \int_{M(T)}^{+\infty} N(m) dm$$

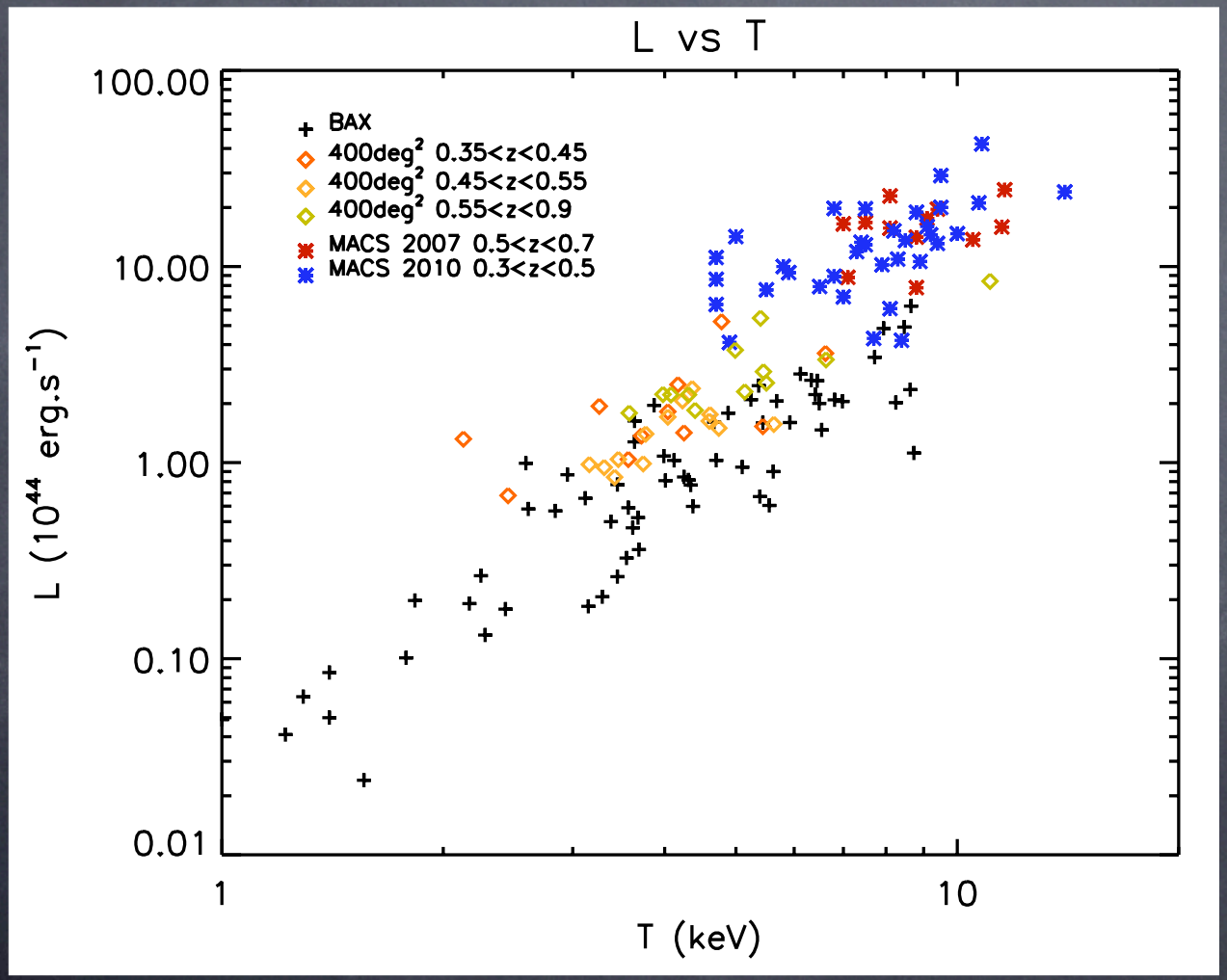
- From the observations

$$N(> k_B T) = \sum_{kT_i > kT} \frac{1}{V(kT_i)}$$

$$\sigma^2(> k_B T) = \sum_{T_i > T} \frac{1}{V^2(k_B T)}$$

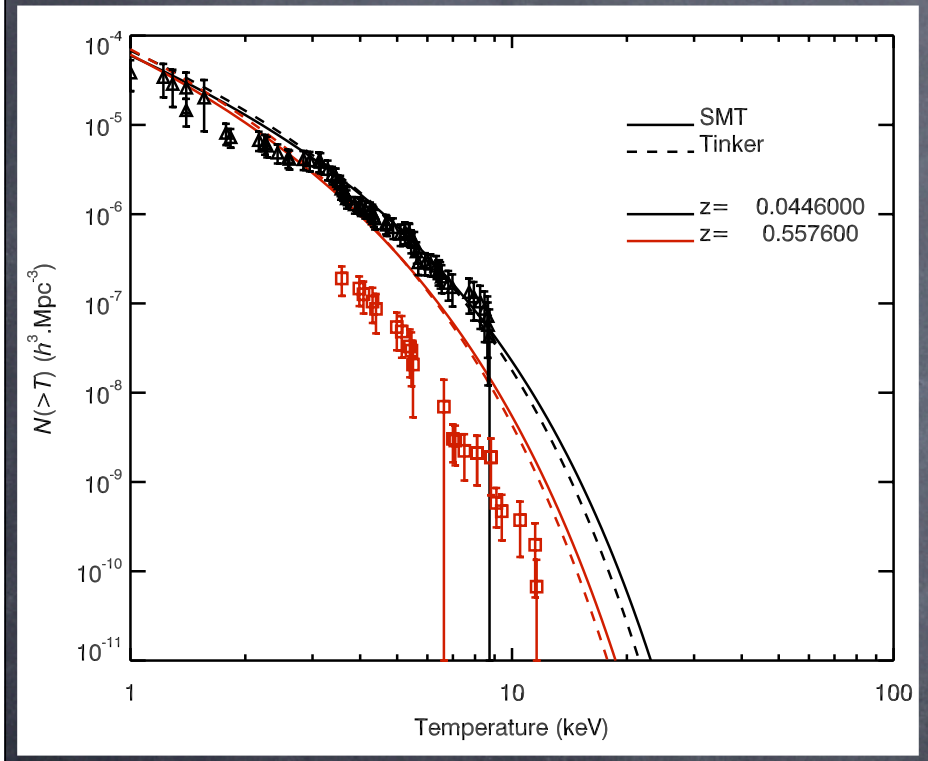
X-ray results

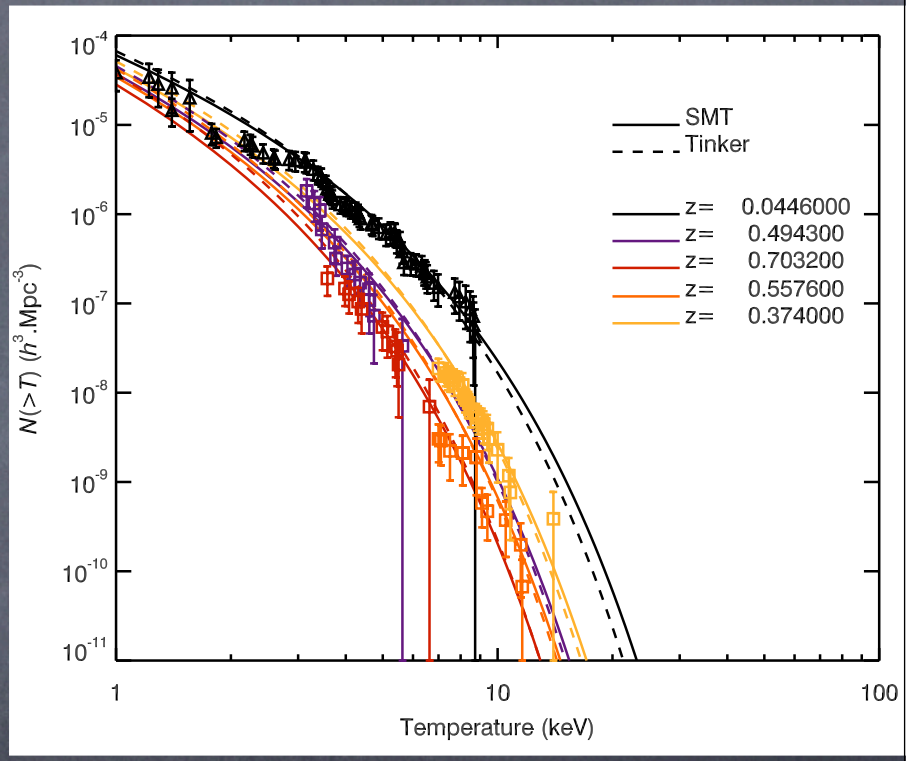
The samples



(see http://bax.ast.obs-mip.fr, Vikhlinin et al.2009, Ebeling et al.2007, Ebeling et al.2010)

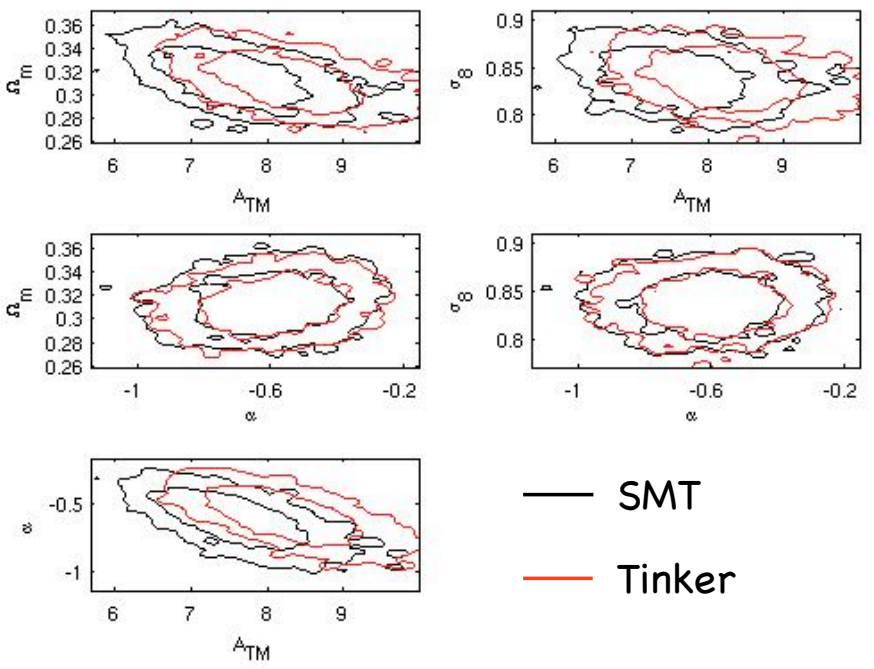
X-ray results





$$T = A_{TM}(hM_v)^{2/3}\left(\Omega_m \frac{\Delta(\Omega_m, z)}{178}\right)^{1/3}(1+z)\,(1+z)^{\alpha}$$

X-ray results



Using all samples

Parameter	Value (SMT)	Value (Tinker)	Parameter Definition
$\Omega_b h^2$	0.02230 ± 0.00055	0.02230 ± 0.00054	Normalized baryon matter density times h^2
$\Omega_c h^2$	0.1190 ± 0.0033	0.1188 ± 0.0031	Normalized CDM density times h^2
θ	1.0381 ± 0.0028	1.0382 ± 0.0027	Ratio of sound horizon to angular diameter distance
τ	0.081 ± 0.013	0.081 ± 0.014	Reionization optical depth
n_s	0.956 ± 0.013	0.957 ± 0.013	Primordial spectral index at $k = 0.05\mathrm{Mpc}^{-1}$
$\log(10^{10} A_s)$	3.090 ± 0.033	3.091 ± 0.034	A_s is the primordial scalar power at $k = 0.05\mathrm{Mpc}^{-1}$
A_{TM}	7.596 ± 0.676	8.278 ± 0.707	Normalization temperature in $T - M$ scaling law
α	-0.614 ± 0.155	-0.59 ± 0.15	Redshift evolution parameter in $T - M$ scaling law
Ω_Λ	0.686 ± 0.018	0.688 ± 0.017	Dark Energy density ($h^2 \rho_\Lambda$)
Age	13.85 ± 0.12	13.85 ± 0.12	Age of the Universe in Gyr
Ω_m	0.313 ± 0.018	0.312 ± 0.017	Normalized matter density
σ_8	0.838 ± 0.022	0.839 ± 0.022	Matter density fluctuation amplitude
z_{re}	10.15 ± 1.18	10.19 ± 1.28	Reionization redshift
h	0.672 ± 0.014	0.673 ± 0.014	Hubble parameter

(Delsart & Blanchard, in prep.)

Modelling of SZ contribution

$$C_l = f(x)^2 \int_0^{z_{max}} dz \frac{dV}{dz d\Omega} \int_{M_{min}}^{M_{max}} dM \frac{dN(M,z)}{dM} |\tilde{y}_l(M,z)|^2$$

$$\tilde{y}_l \propto \int_0^{+\infty} T(r) n_e(r) \frac{\sin(lr/D_A)}{lr/D_A} r^2 dr$$

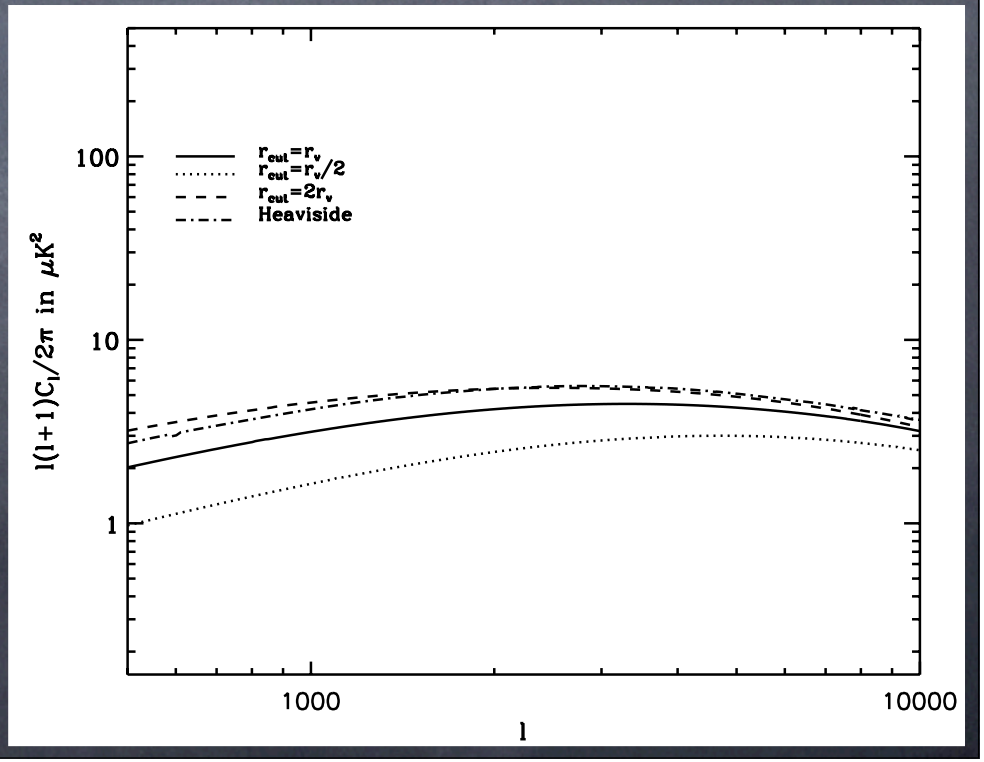
- Use of a scaling relation *T-M*
- Need gas profil

Modelling of SZ contribution

Gas profil and scaling law

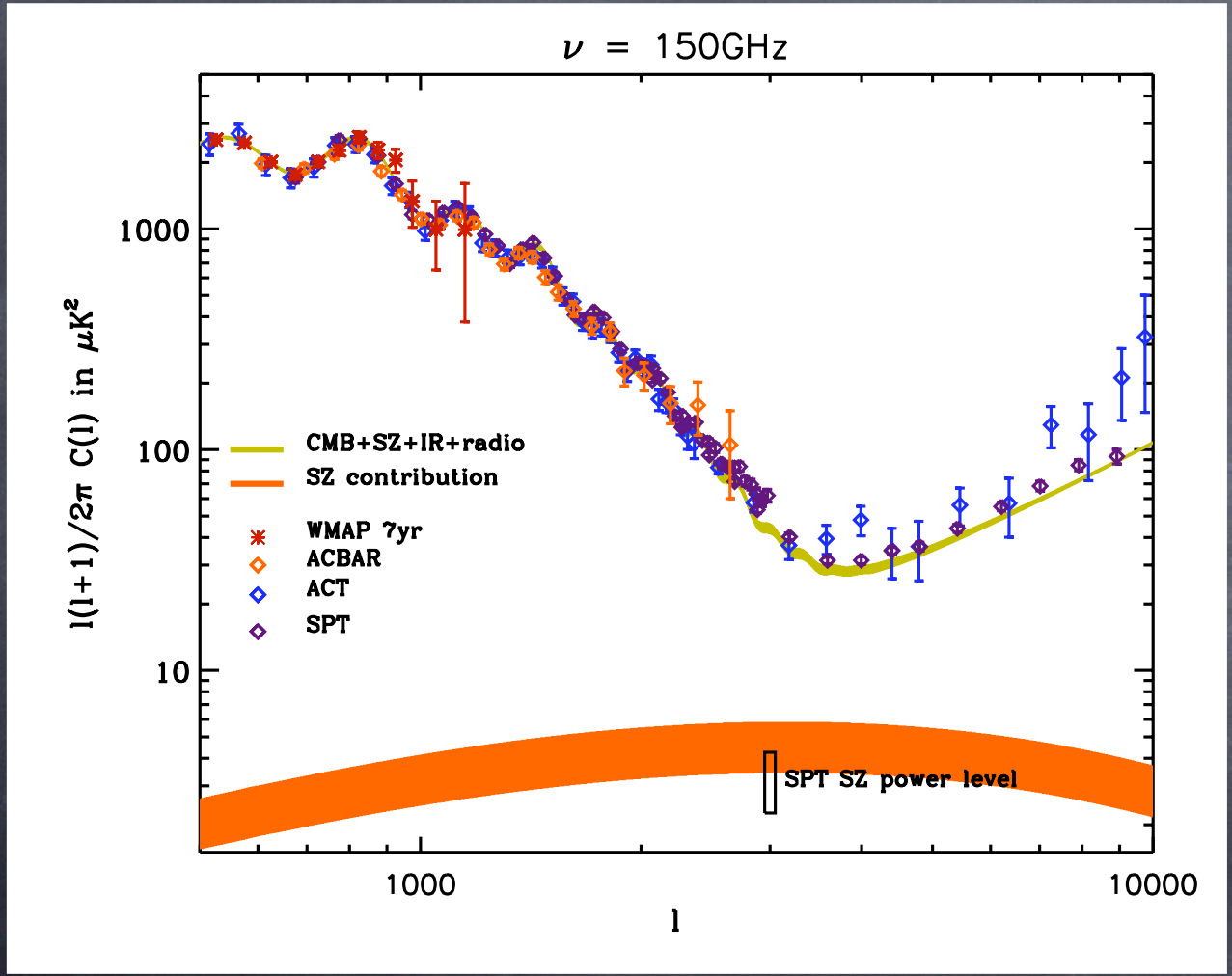
Simple β-model ⟶ β=0.8

Exponential cut in radius $\propto \exp\left(-\frac{r^2}{r_v^2}\right)$.



$T_{gas} = \xi T_X$ with $\xi = 0.6$

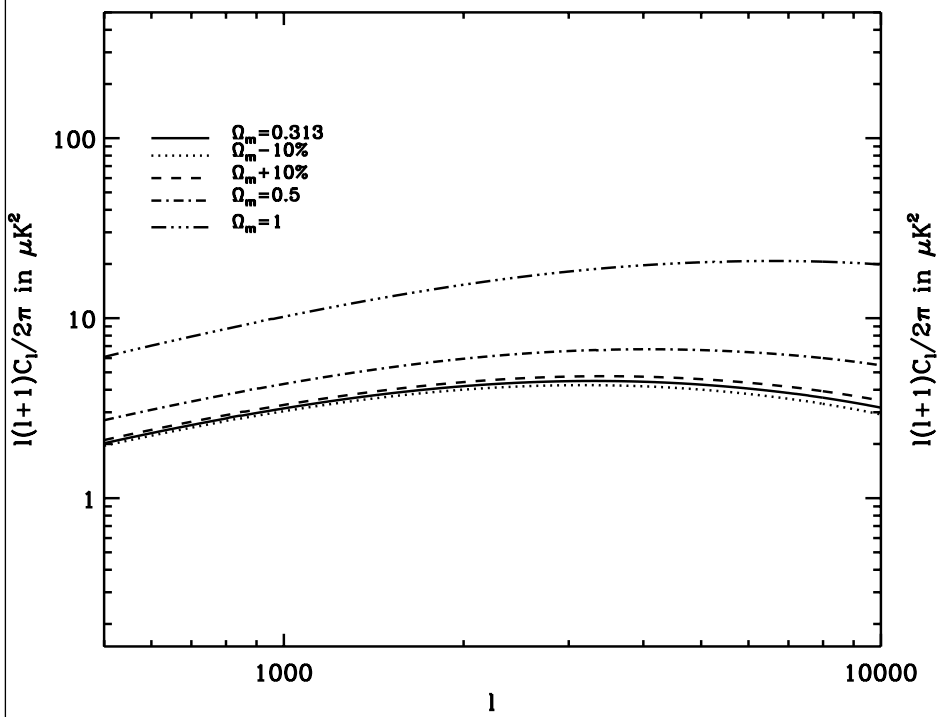
Modelling of SZ contribution

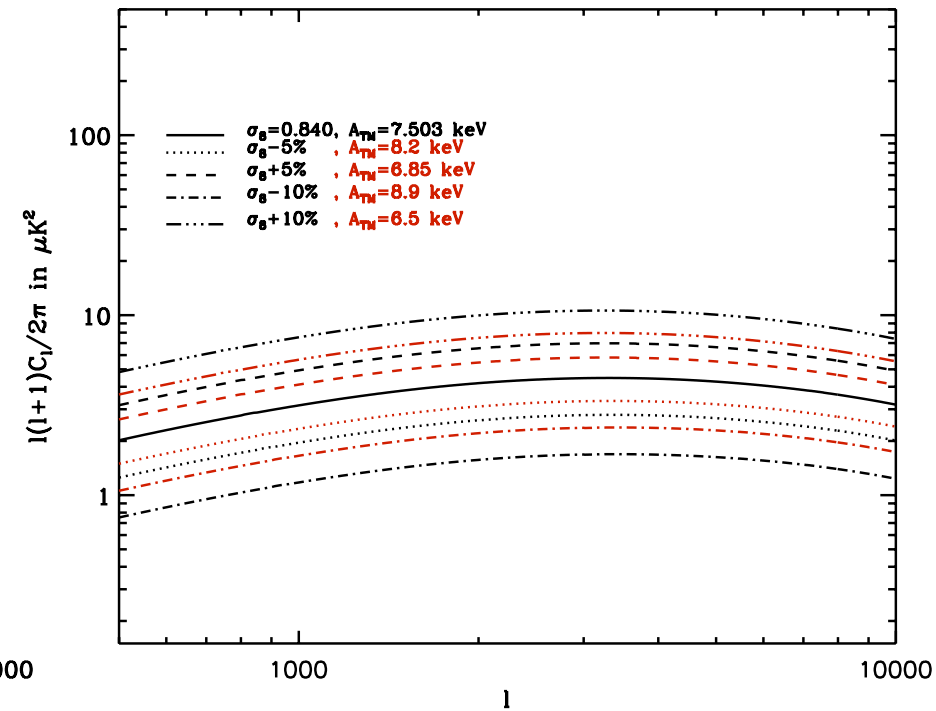


- Reichard et al.2009
- Das et al.2010
- Keissler et al.2011
- Reichard et al.2011

Results on the SZ power spectrum

Dependency on cosmological parameters

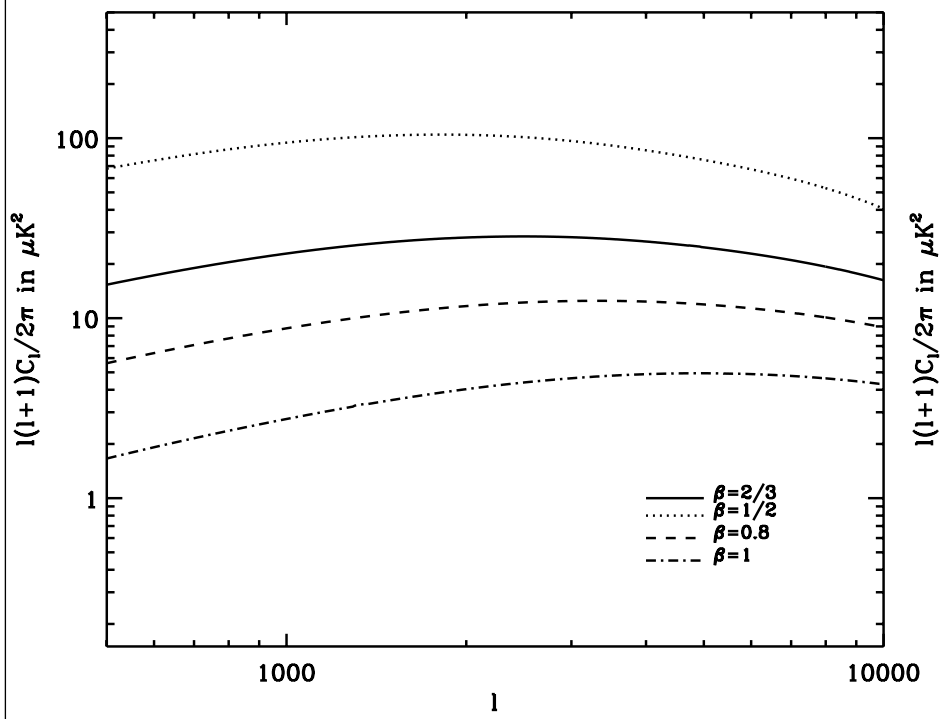


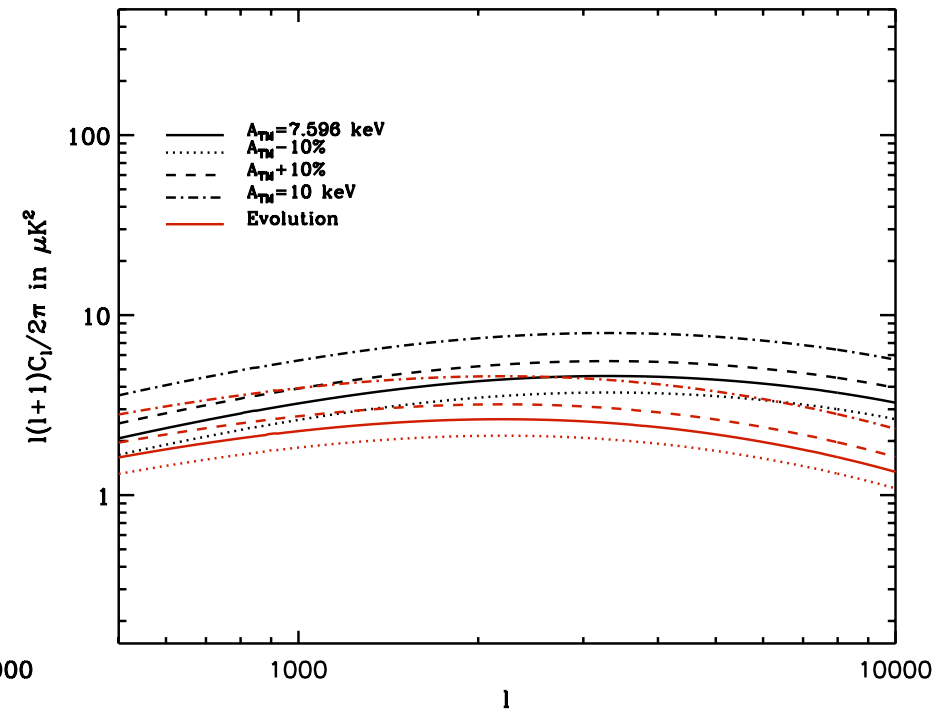


Keep the self-consistency with X-ray

Results on the SZ power spectrum

Dependency on scaling law and gas profil parameters

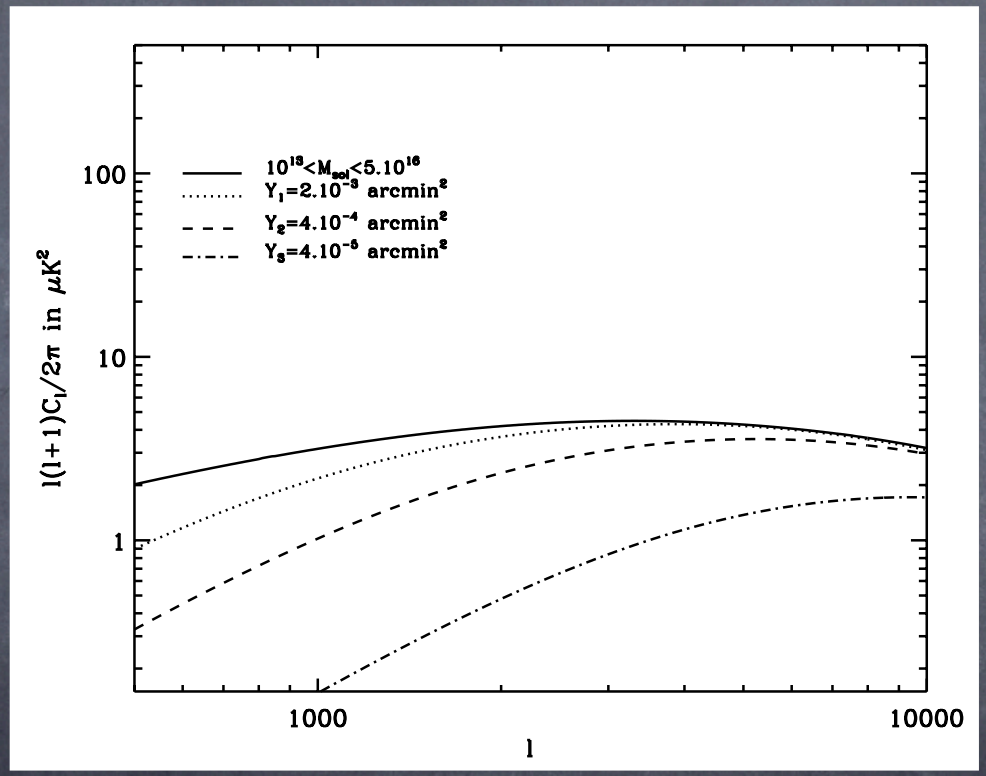




Effect of redshift evolution

Results on the SZ power spectrum

SZ flux cut-off

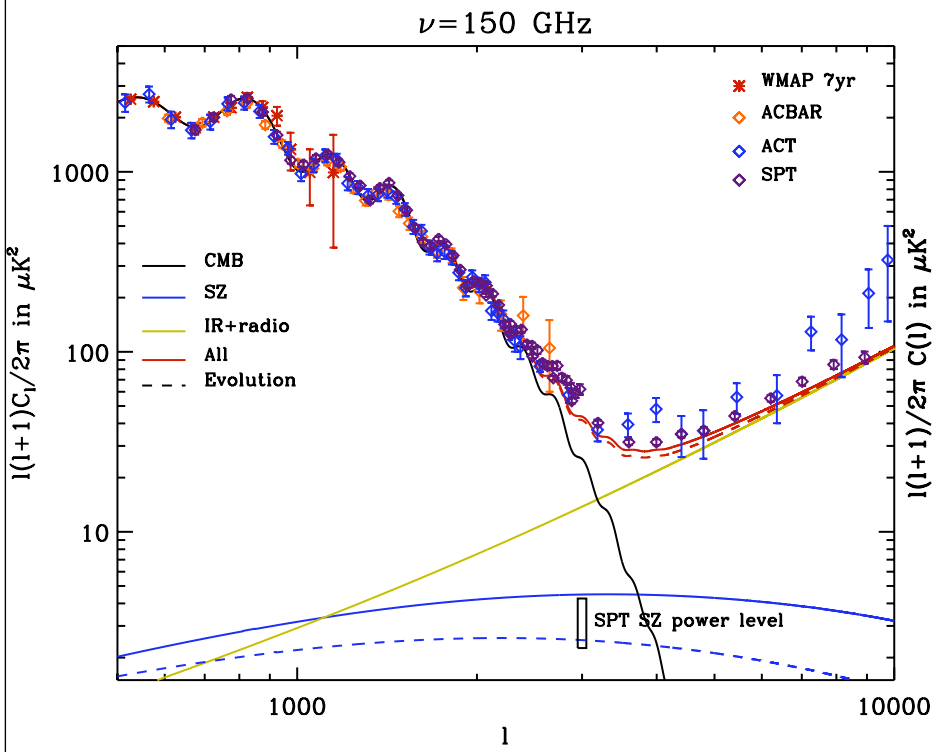


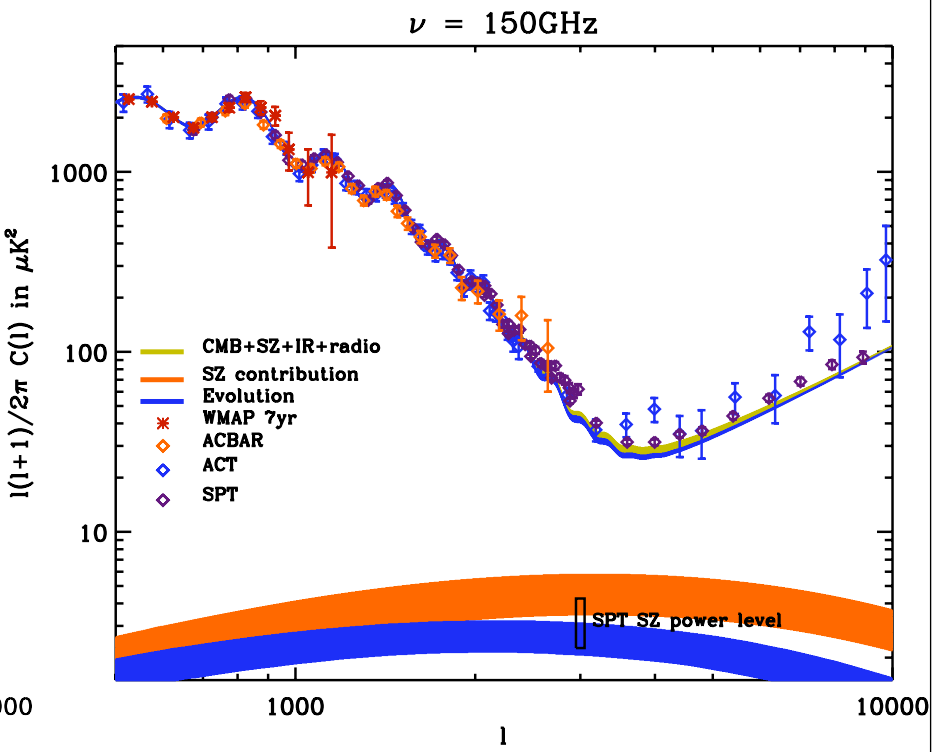
$$Y \propto \xi A_{TM} f_B M_v^{5/3} h^{8/3} \left(\Omega_m \frac{\Delta}{178}\right) (1+z)^{1+\alpha} D^{-2}$$

(see Delsart et al., A&A 2010, 524, A81)

Results on the SZ power spectrum

Total CMB power spectrum





(Delsart, Barbosa & Blanchard, in prep.)

Conclusion

X-ray observations suggest evolution in *T-M*

Evolution measured and constrained

Errors on the modelling due to cosmological parameters are reasonable

Strongly dependant of gas profil parameters

Evolution is one of possible solution to explain decrement in the SZ part

Thank you for your attention