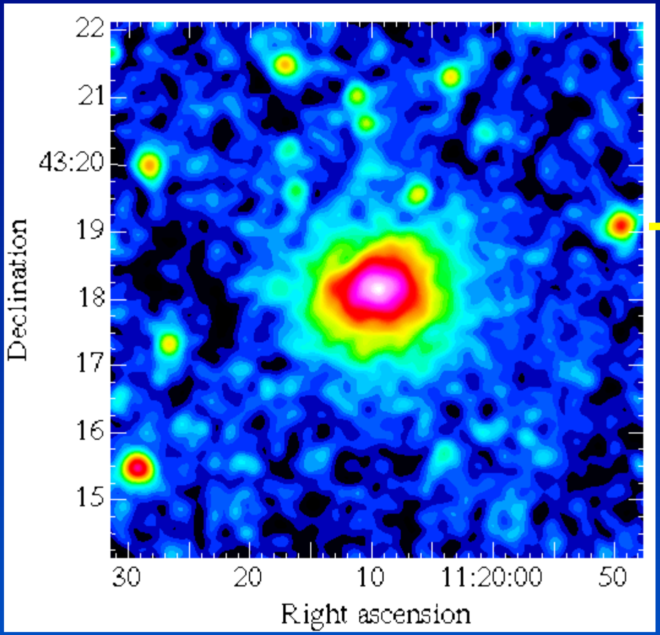
Need for <u>global</u> estimates of Ω_m !!!

Ω_m

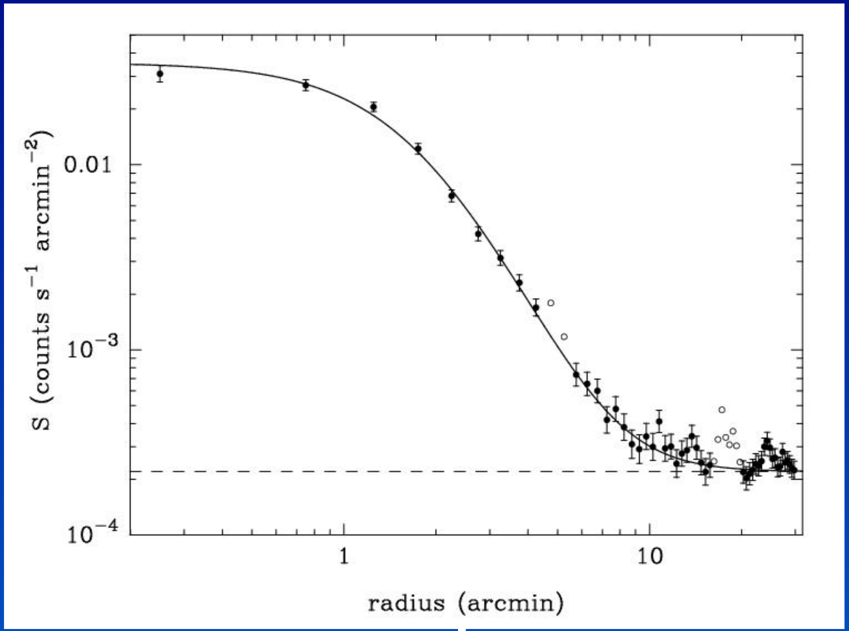
From X-ray Clusters

Baryon Fraction

What do you do with a cluster?

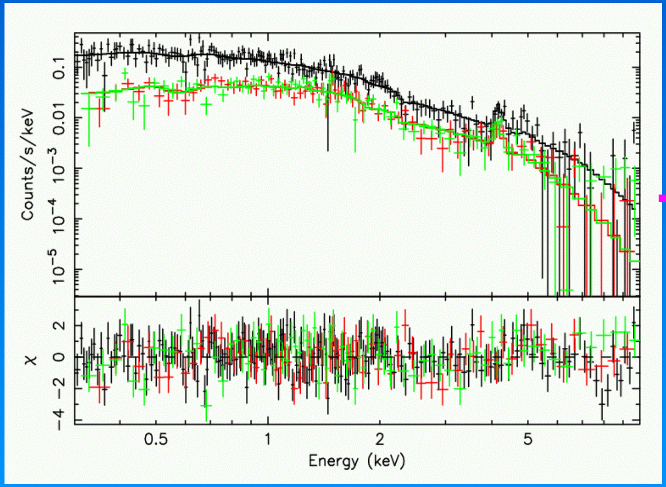


Fit

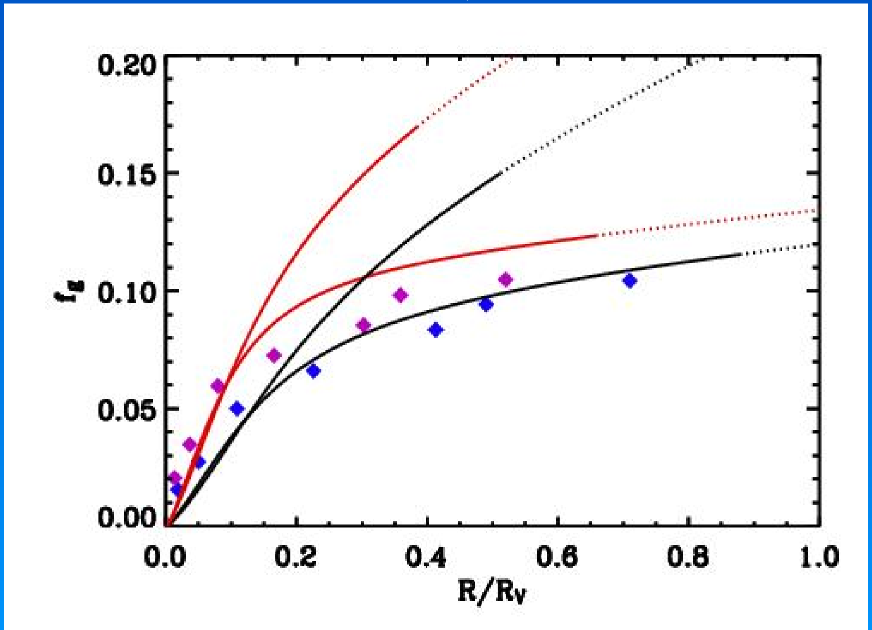


Gas mass $M_g(r)$

X-ray spectrum



M(r)



Method :

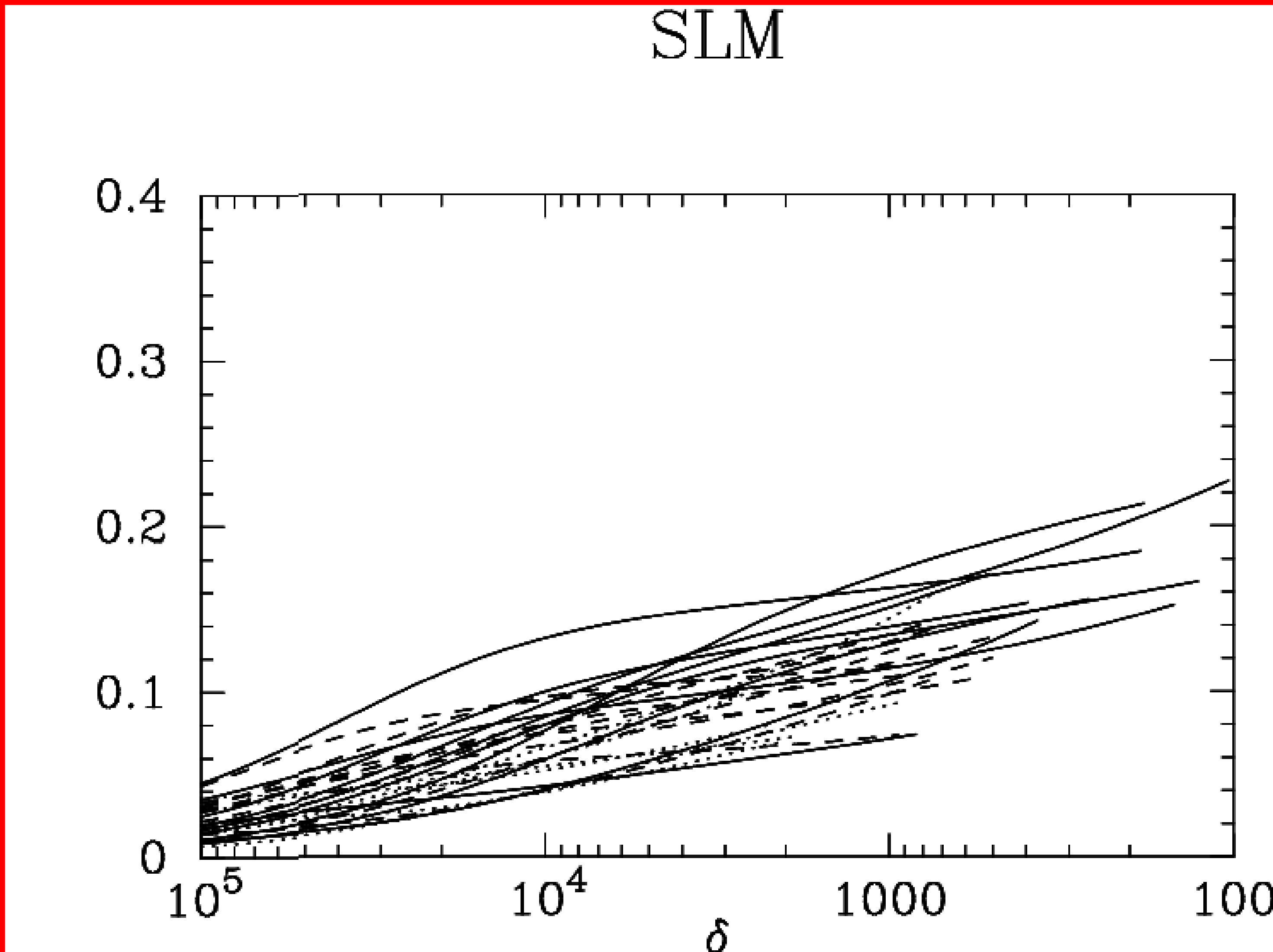
Ratio : $f_b = M_b/M_t$

Observations ⇒ $M_g,\ T_x \square M_t$

i.e. : $f_b \approx 15.\text{-}20.\ h_{50}^{-3/2}\ \%$

Cosmology : $f_b = \Omega_{bbn}/\Omega_0$

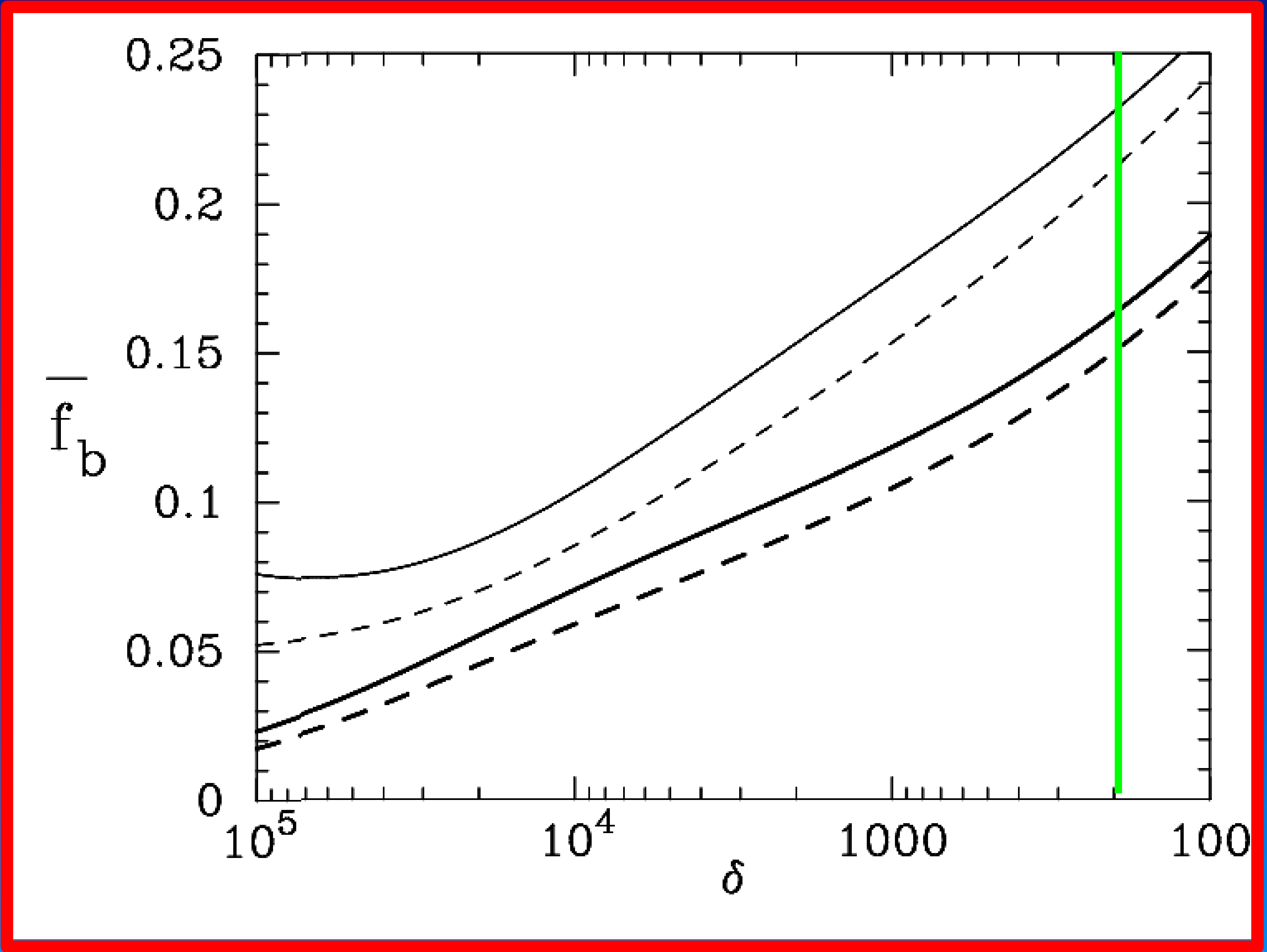
Scaling of baryon fractions :



Cargèse2008.

Roussel et al, 2000

Average baryon fraction :



Cargèse2008.

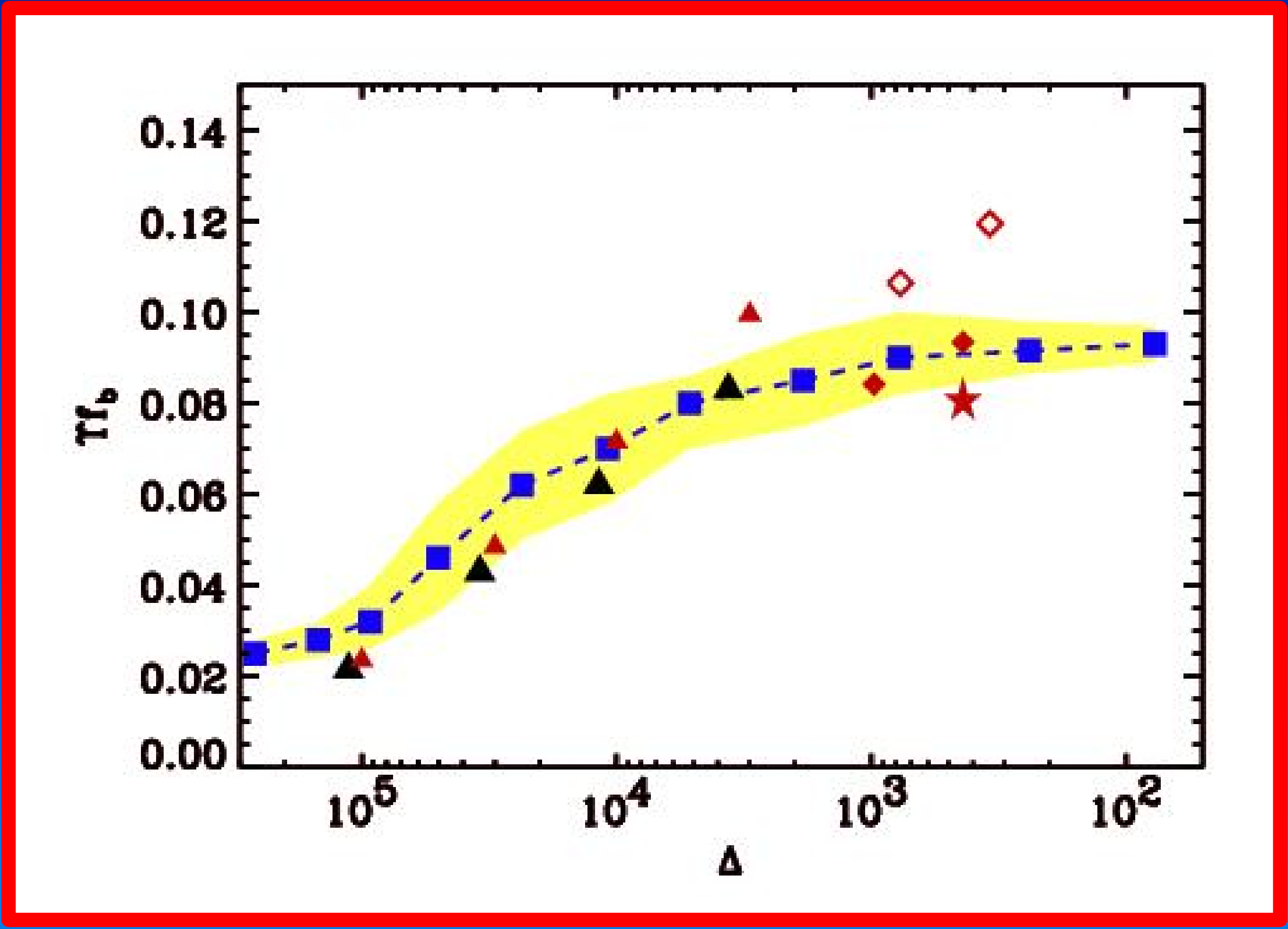
Roussel et al, 2000

Three correcting factors :

- Mass estimator
- Clumping of the gas
- Outer emission

Sadat & Blanchard, 2001

Baryon Fraction @ z = 0



R_{2000} & R_{1000} in Vikhlinin, Forman, Jones 1999 (~35% & 50% Rv)

Conclusion

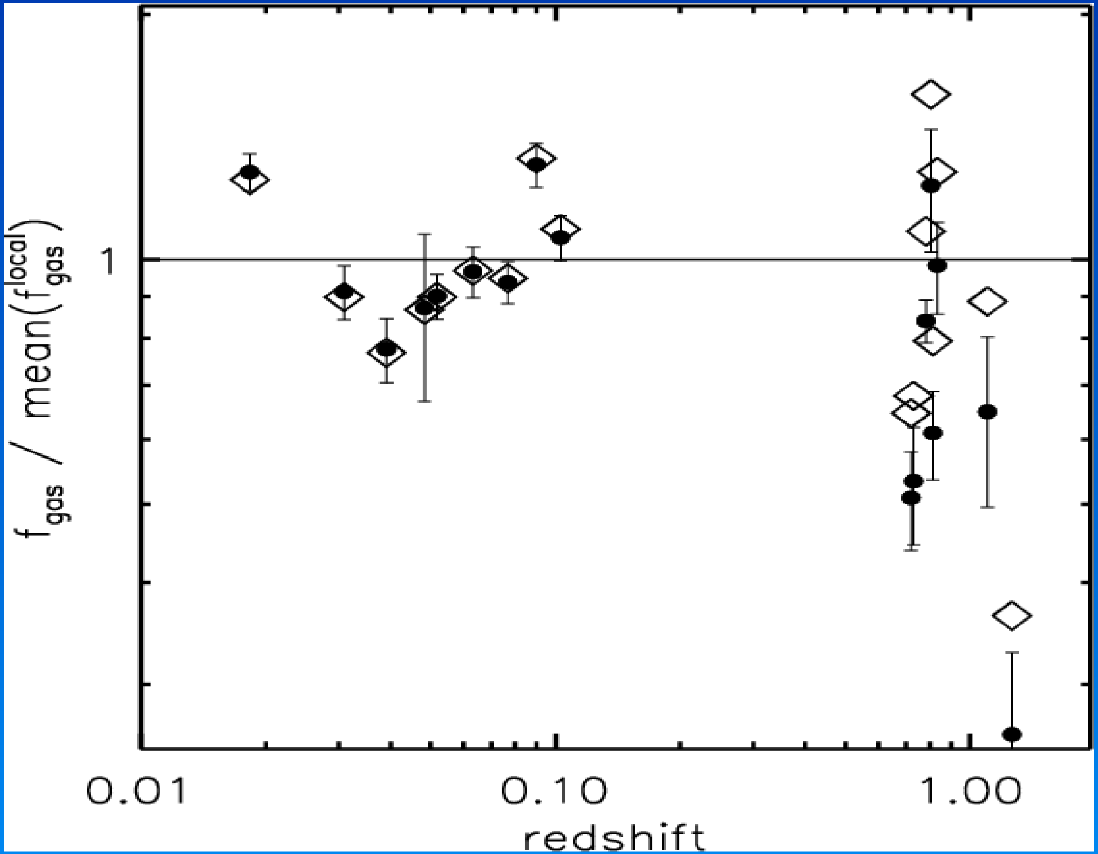
A baryon fraction of the order of $10.\ h_{50}^{-3/2}\ \%$ **or less could be consistent with data...**

Ω_m

From X-ray Clusters

Baryon Fraction evolution

Baryon Fraction (non)evolution as a test of Ω_m



Chandra

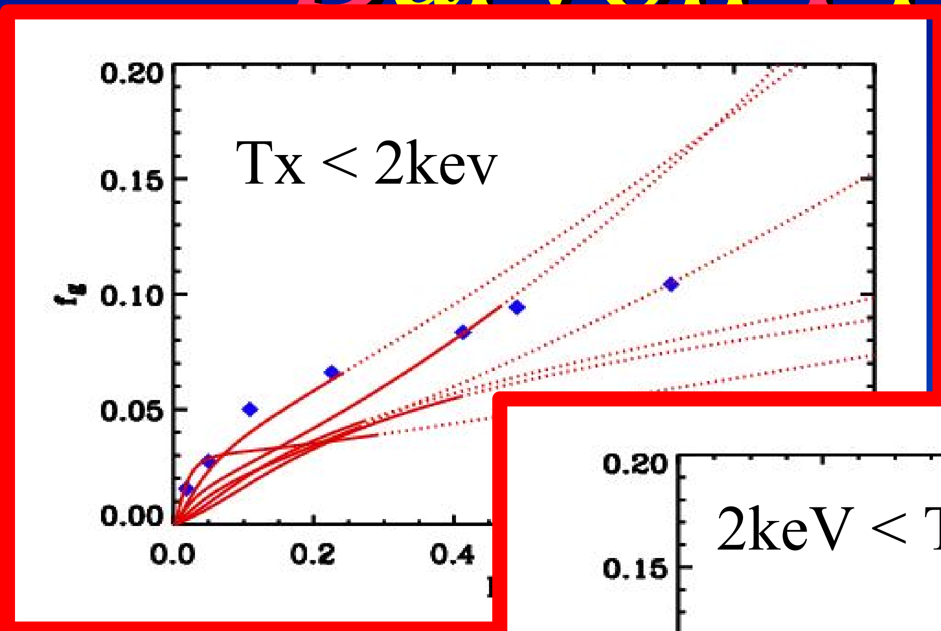
Ω_m

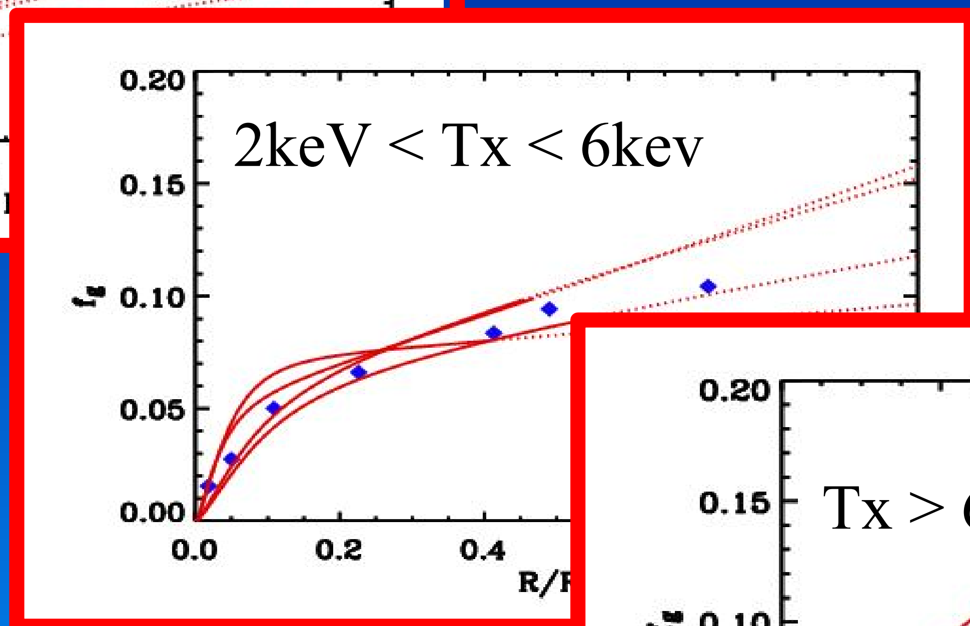
From X-ray Clusters

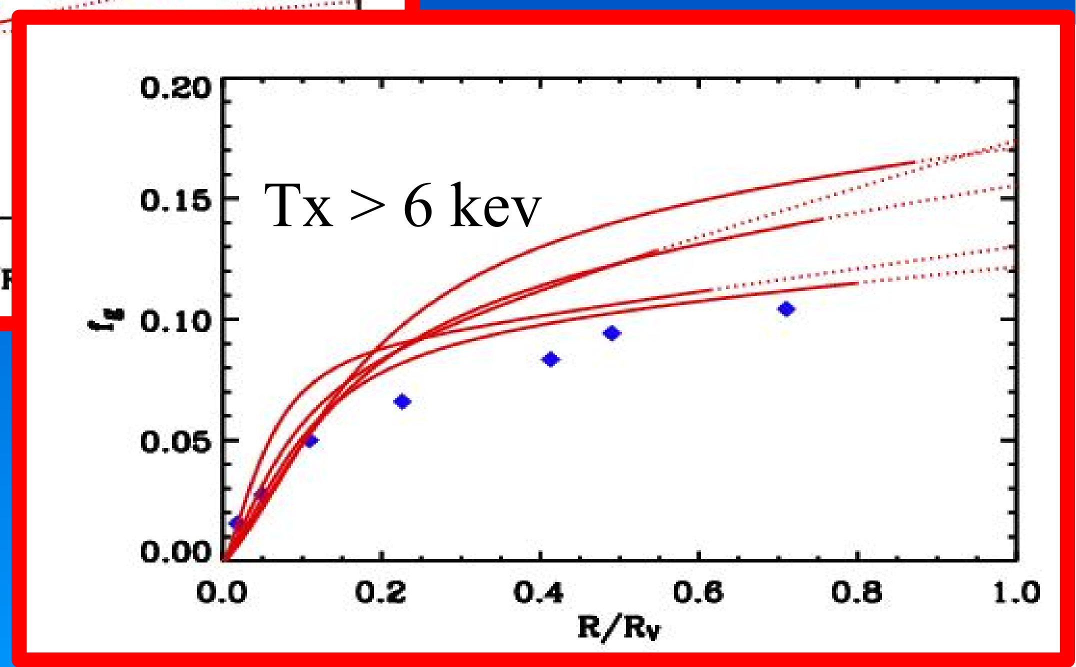
Baryon Fraction evolution in the XMM Ω-project

(Sadat et al., 2005)

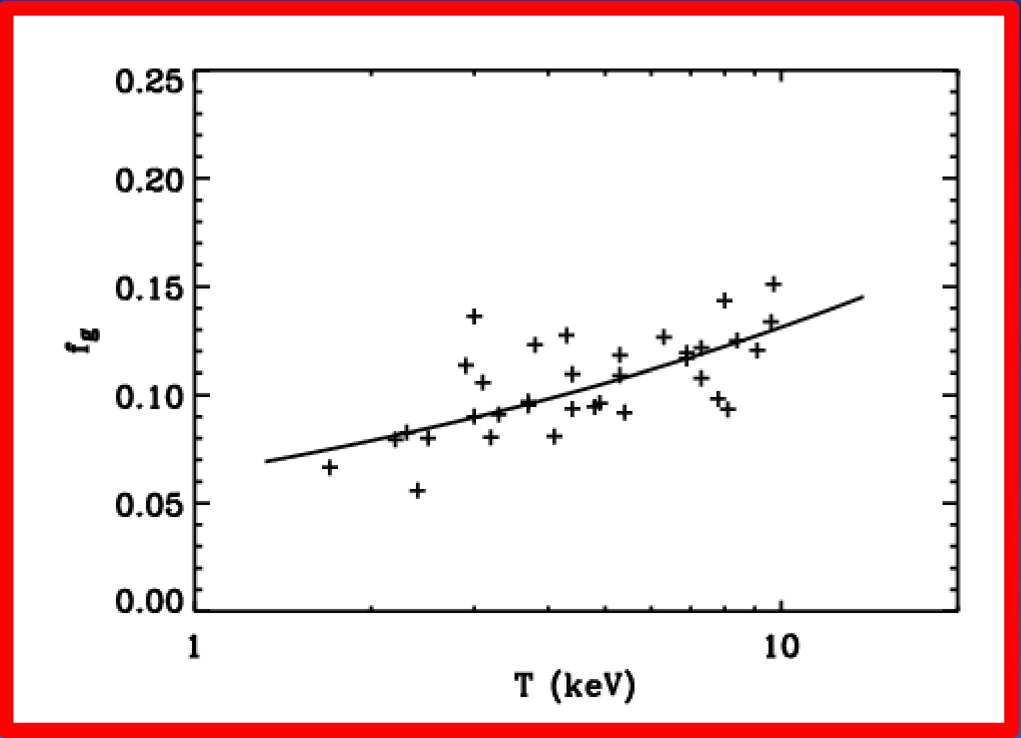
Barvon Fraction @ z = 0





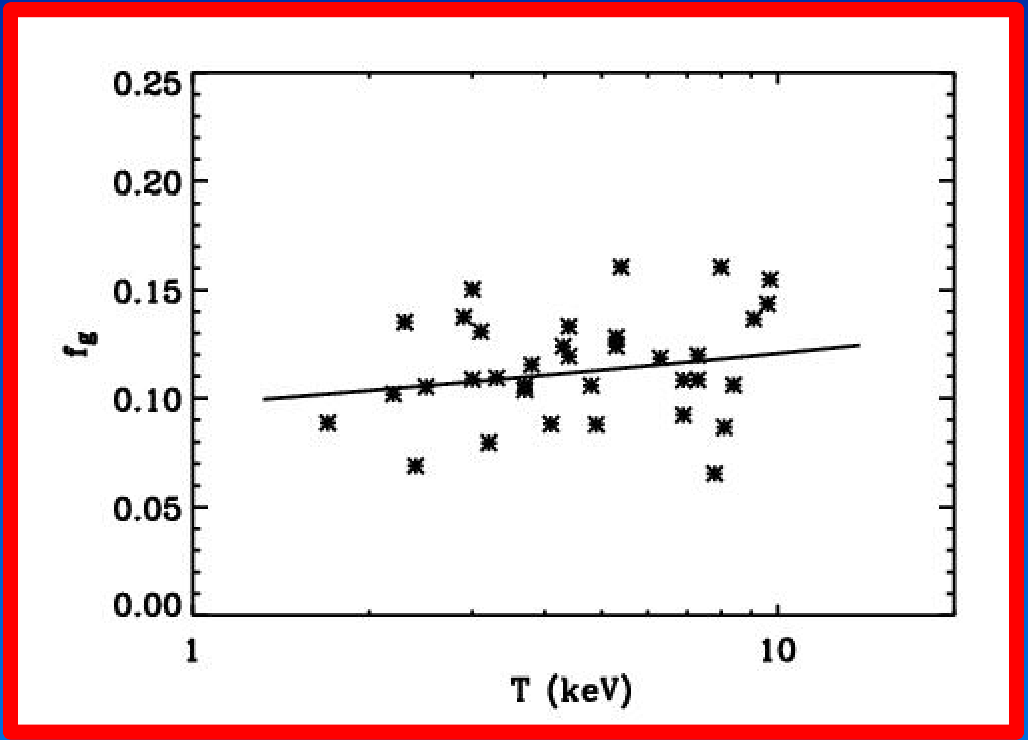


Baryon Fraction @ z = 0



R_{2000} in Vikhlinin, Forman, Jones 1999 (~35-45% Rv)

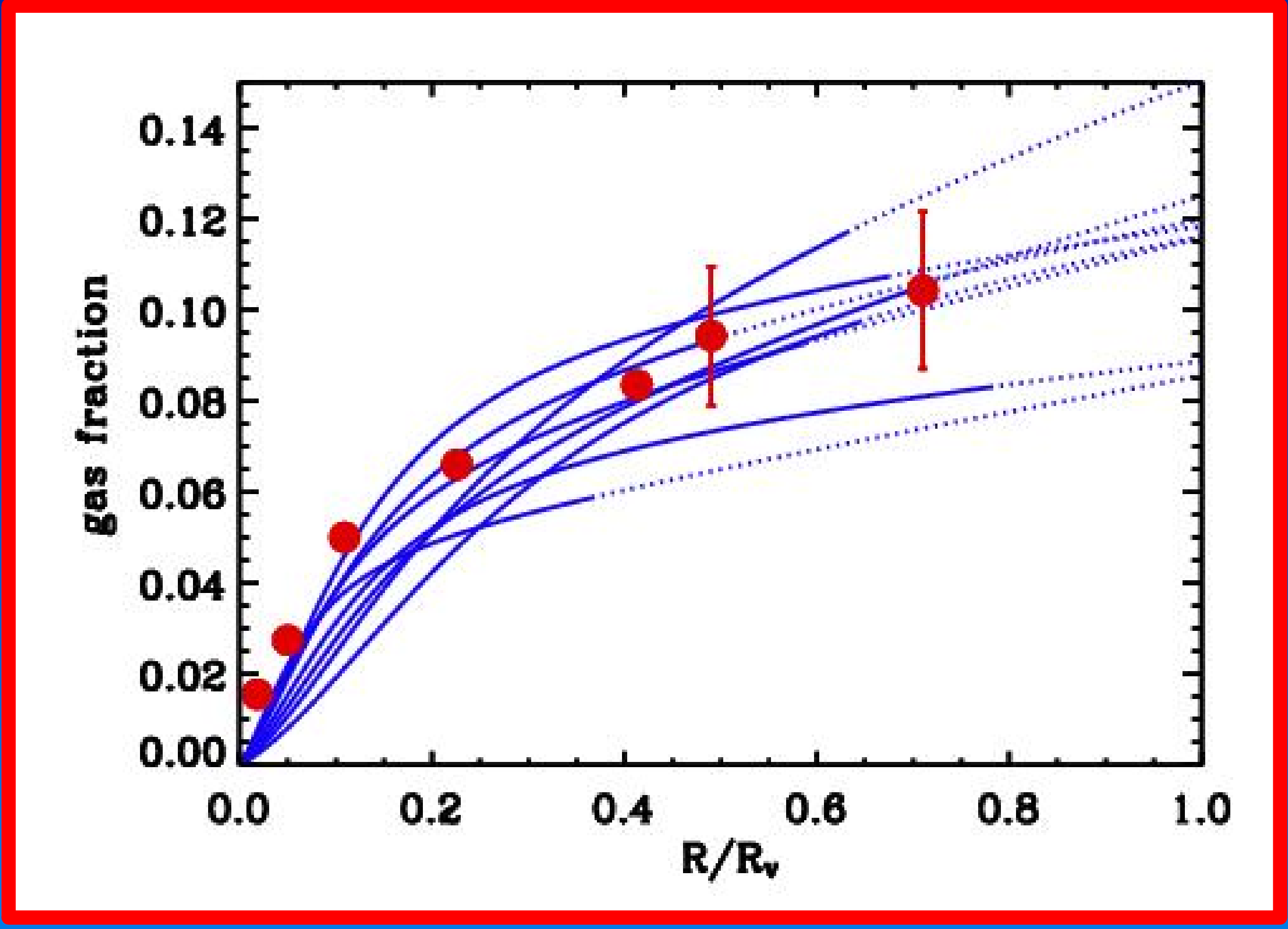
Baryon Fraction @ z = 0



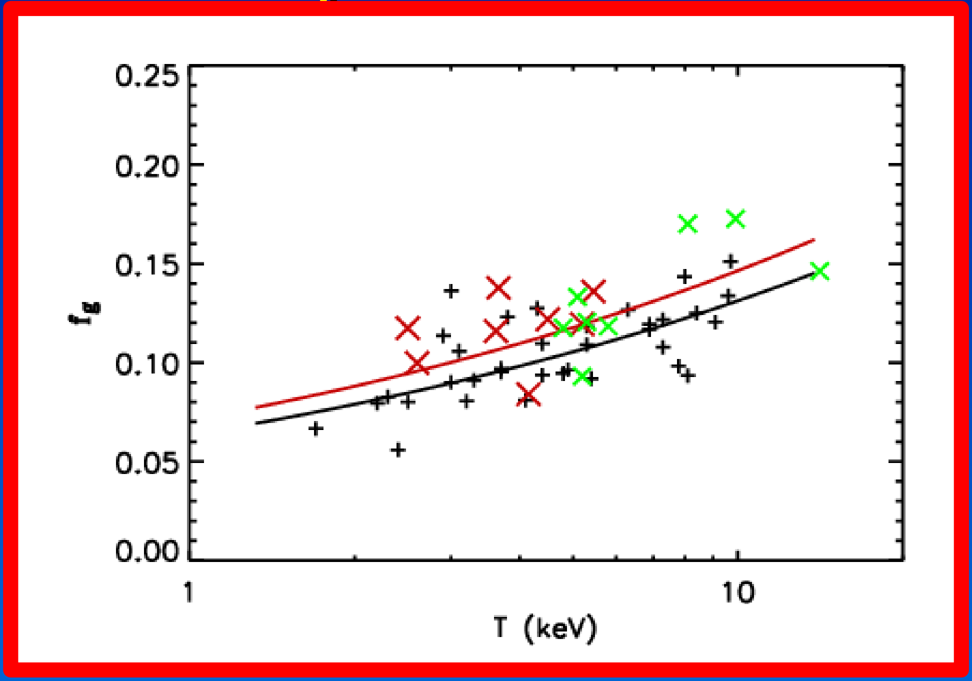
R_v in Vikhlinin, Forman, Jones 1999

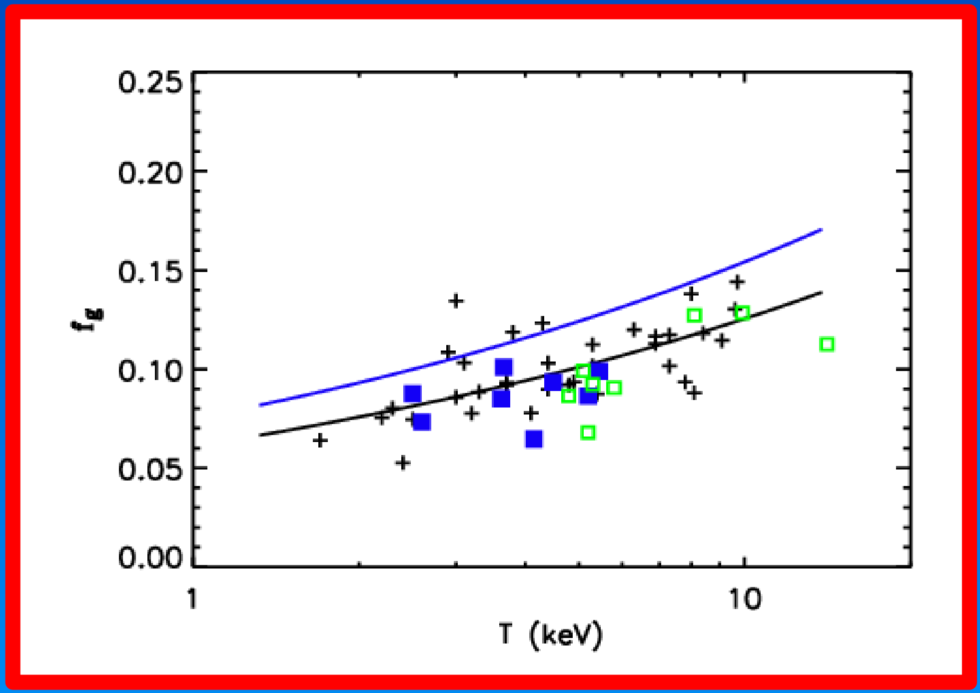
I Evidencing (non-)scaling relations of X-ray clusters in the local universe

Baryon Fraction @ z = 0.6



Baryon Fraction @ z = 0.6

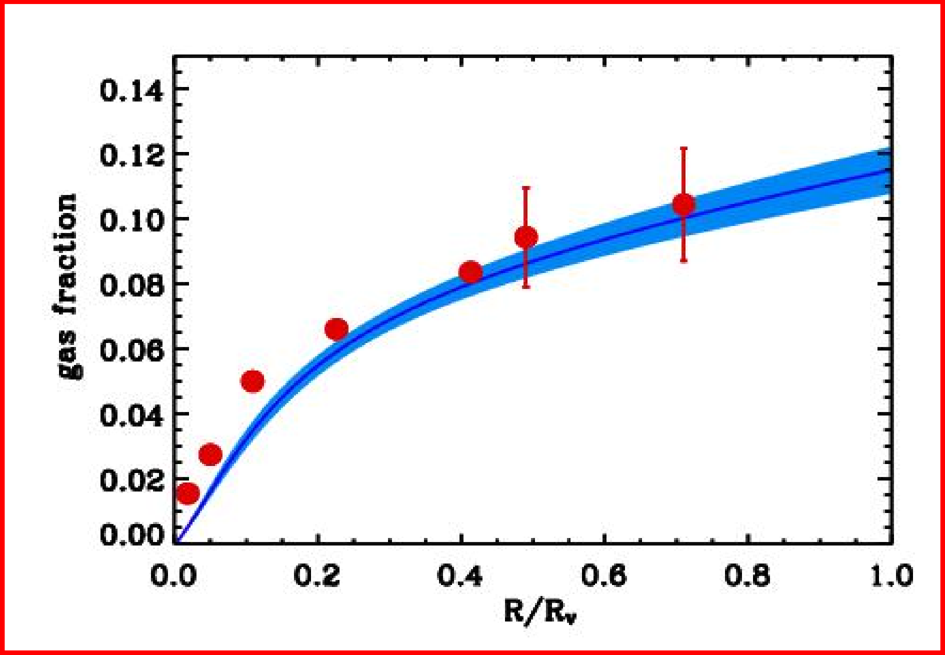




$\Delta = 2000$

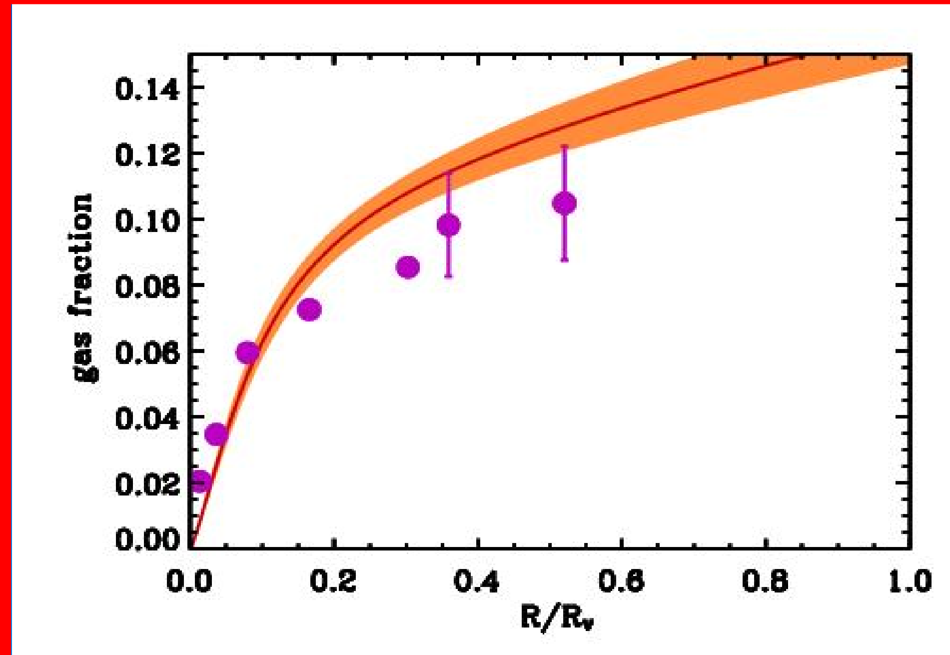
Cargèse2008.

Baryon Fraction @ z = 0.6

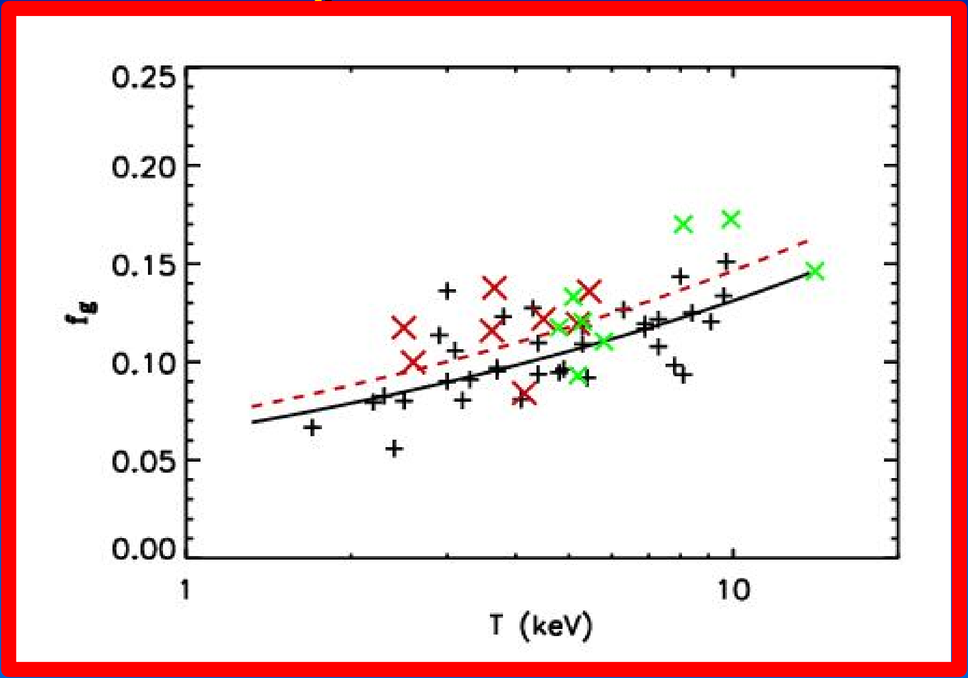


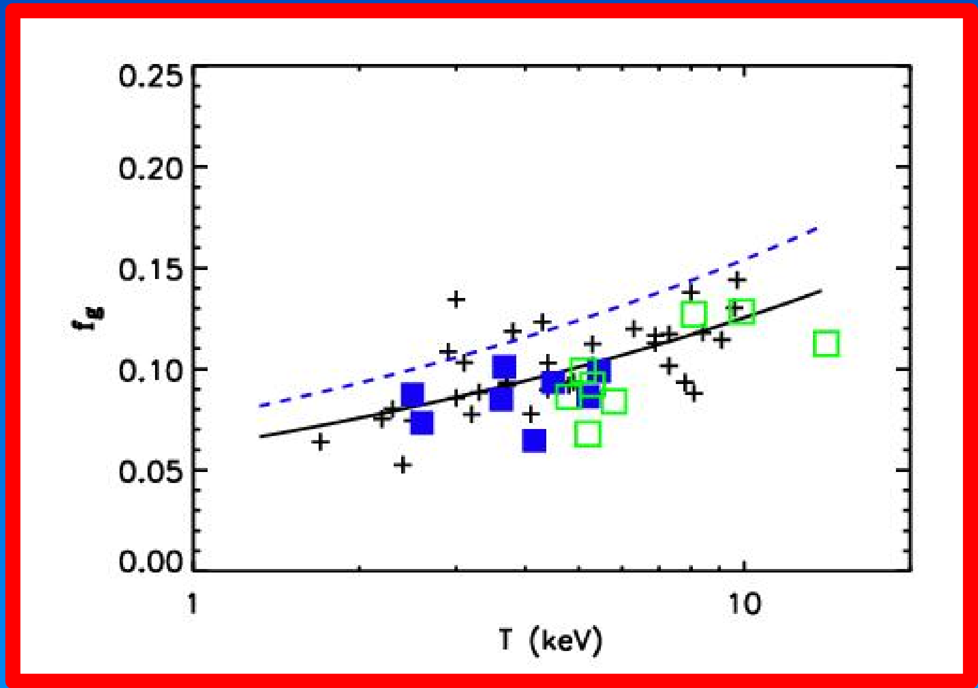
Internal structure

is complex...



Baryon Fraction @ z = 0.6

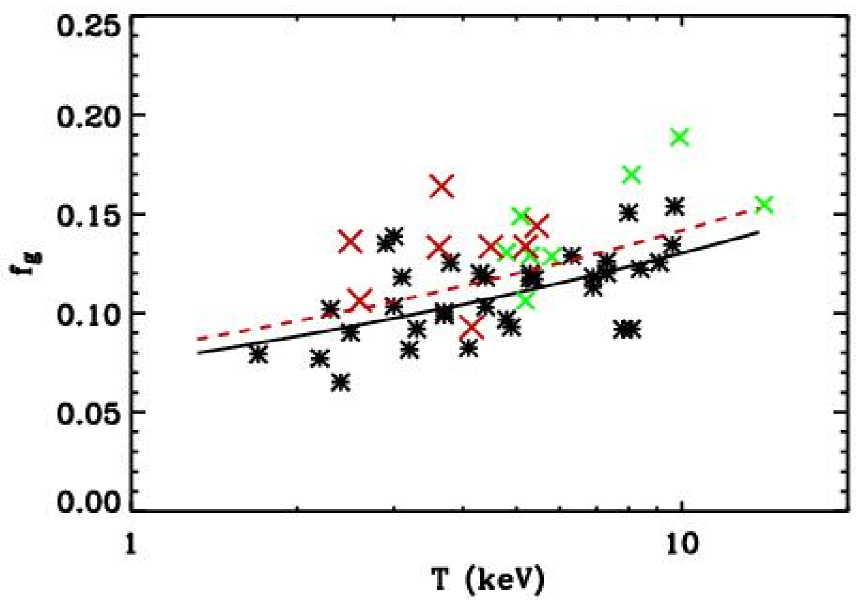


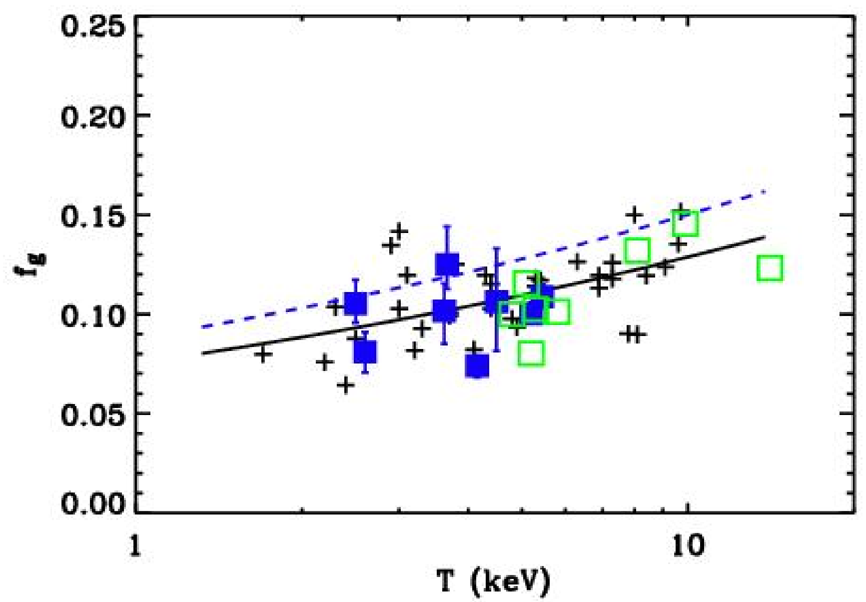


$\Delta = 2000$

Cargèse2008.

Baryon Fraction @ z = 0.6

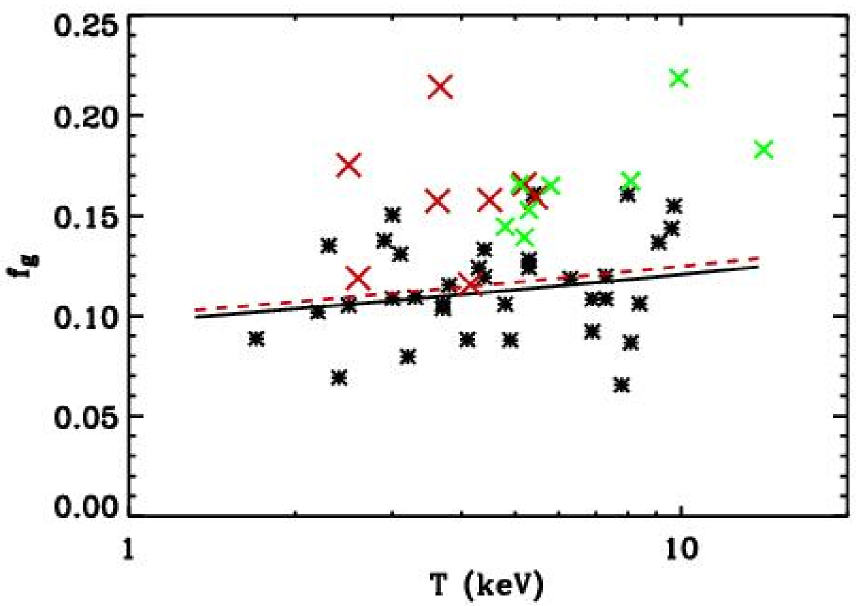


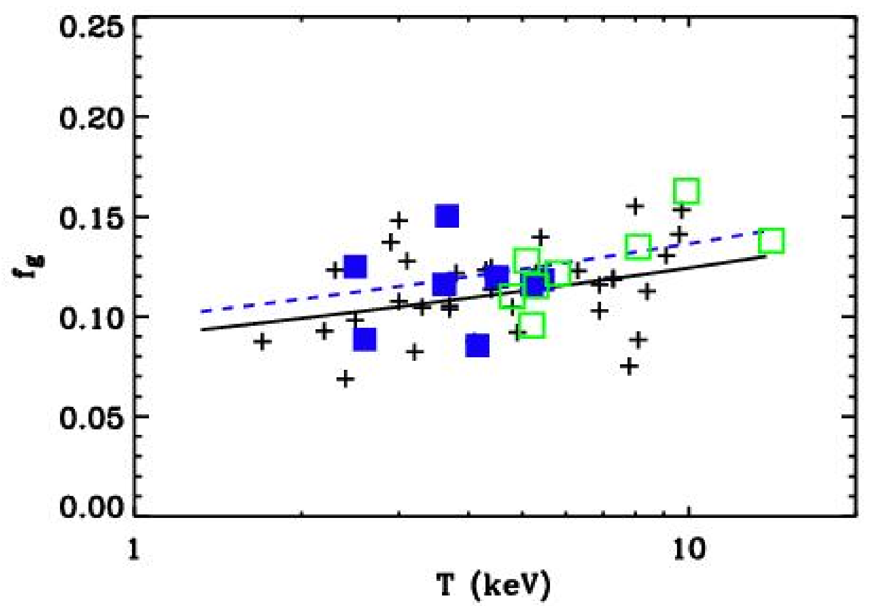


$\Delta = 1000$

Cargèse2008.

Baryon Fraction @ z = 0.6

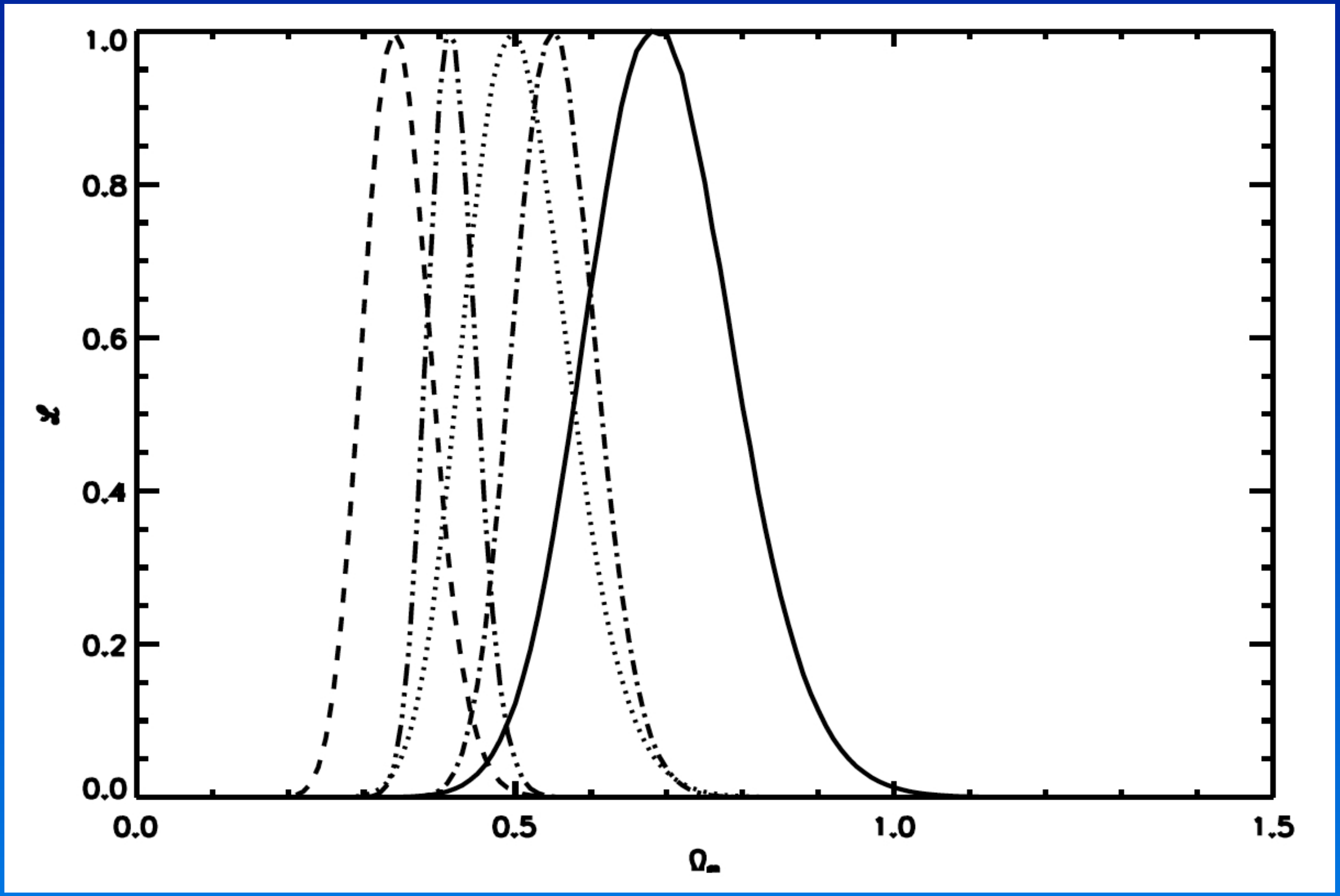




Δ_v

Cargèse2008.

Likelihood analysis:



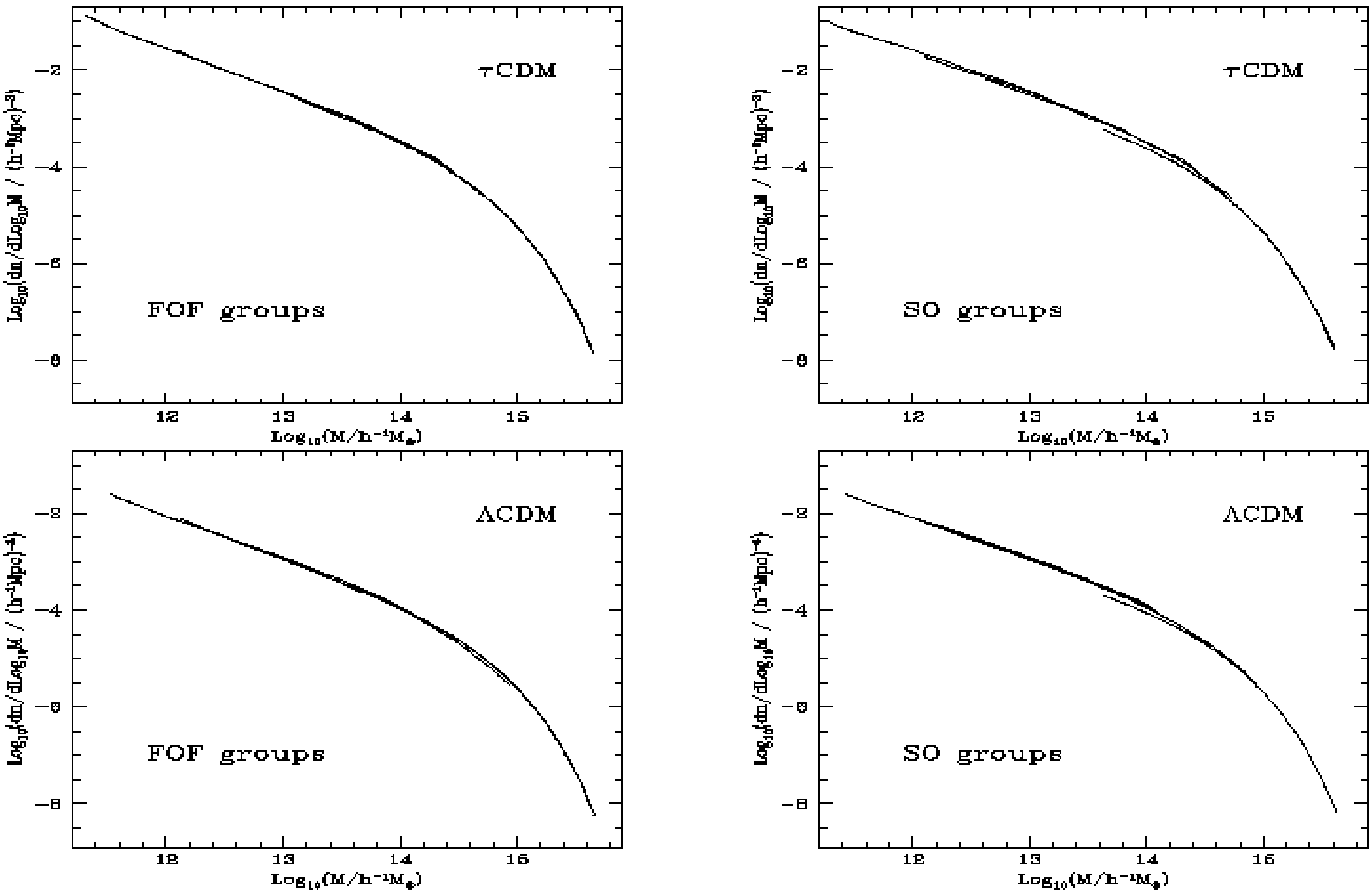
(Ferramacho, L. & B.A., 2007)

Ω_m From X-ray Clusters

Abundance evolution

Theory of the mass function

4 *A. Jenkins et al.*



Cargèse2008.

Basics

Matter = random field:

$$\rho(x) = \overline{\rho}(1 + \delta(x))$$

δ mathematically ill-behaved...

1. The field is smoothed = ρ is convolved:

$$\tilde{\delta} = \delta * W_R$$

with a window function:

$$\int W_R(u) du = 1$$

the smoothed field:

$$\tilde{\delta}(x) = \int \delta(x+u) W_R(u) du$$

Variance of the field :

$$\overline{\tilde{\delta}^2(x)} = \sigma^2(R)$$

Ex: top-hat window:

$$W_R(u) = 1/V \quad \text{for} \quad |u| < R$$
$$W_R(u) = 0. \quad \text{for} \quad |u| \geq R$$

Mass associated:

$$M(R) = \frac{4\pi}{3} R^3 \overline{\rho}$$

2. Nonlinear model

- linear overdensity $\tilde{\delta}(x) \sim 1$

Ex: spherical model $\delta_{NL}(z, \Omega_m, \Omega_\lambda \ldots)$

3. Mass function:

- trivially (!): dV will be in an object with mass > M if included in a NL fluctuation of $\tilde{\delta}_R$ with radius > R

$$\int_M^{+\infty} m n(m) dm = \overline{\rho} \int \mathcal{F}_\delta(\delta) s(\delta) d\delta \sim \overline{\rho} \int_{\delta_{NL}}^{+\infty} \mathcal{F}_\delta(\delta) d\delta$$

or (sharp threshold):

$$\int_M^{+\infty} m n(m) dm = \overline{\rho} \int_{\delta_{NL}}^{+\infty} \mathcal{F}_\delta(\delta) d\delta = \overline{\rho} \int_{\nu_{NL}}^{+\infty} \mathcal{F}(\nu) d\nu$$

with:

$\delta = \nu\sigma(R) = \nu\sigma(M)$ and $\nu_{NL} = \frac{\delta_{NL}}{\sigma(M)}$

and just take the derivative...

the mass function:

$$N(M) = -\frac{\overline{\rho}}{M^2\sigma(M)}\delta_{NL}\frac{d\ln\sigma}{d\ln M}\mathcal{F}(\nu_{NL})$$

normalization condition:

$$\frac{1}{\overline{\rho}}\int_0^{+\infty} mn(m)dm = \int_0^{+\infty}\mathcal{F}(\nu)d\nu = 1$$

Press and Schechter (1974) used:

$$\mathcal{F}(\nu) = \sqrt{\frac{2}{\pi}} \exp(-\frac{\nu^2}{2})$$

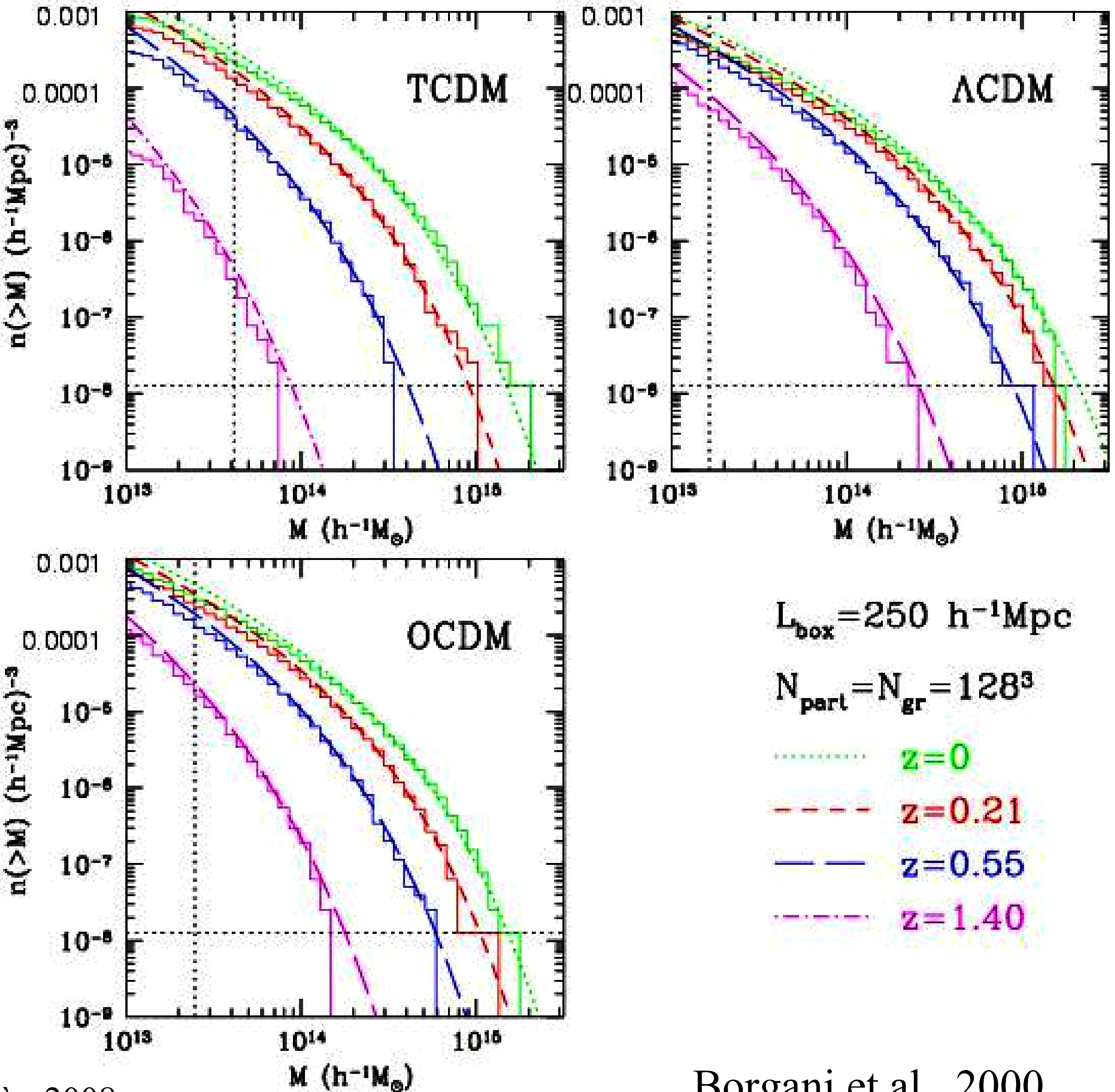
major recent improvements:

$$\mathcal{F}(\nu) = \sqrt{\frac{2A}{\pi}} C \exp(-0.5 A\nu^2)(1. + (A\nu)^2)^Q)$$

with $A = 0.707 \ C = 0.3222 \ Q = 0.3$

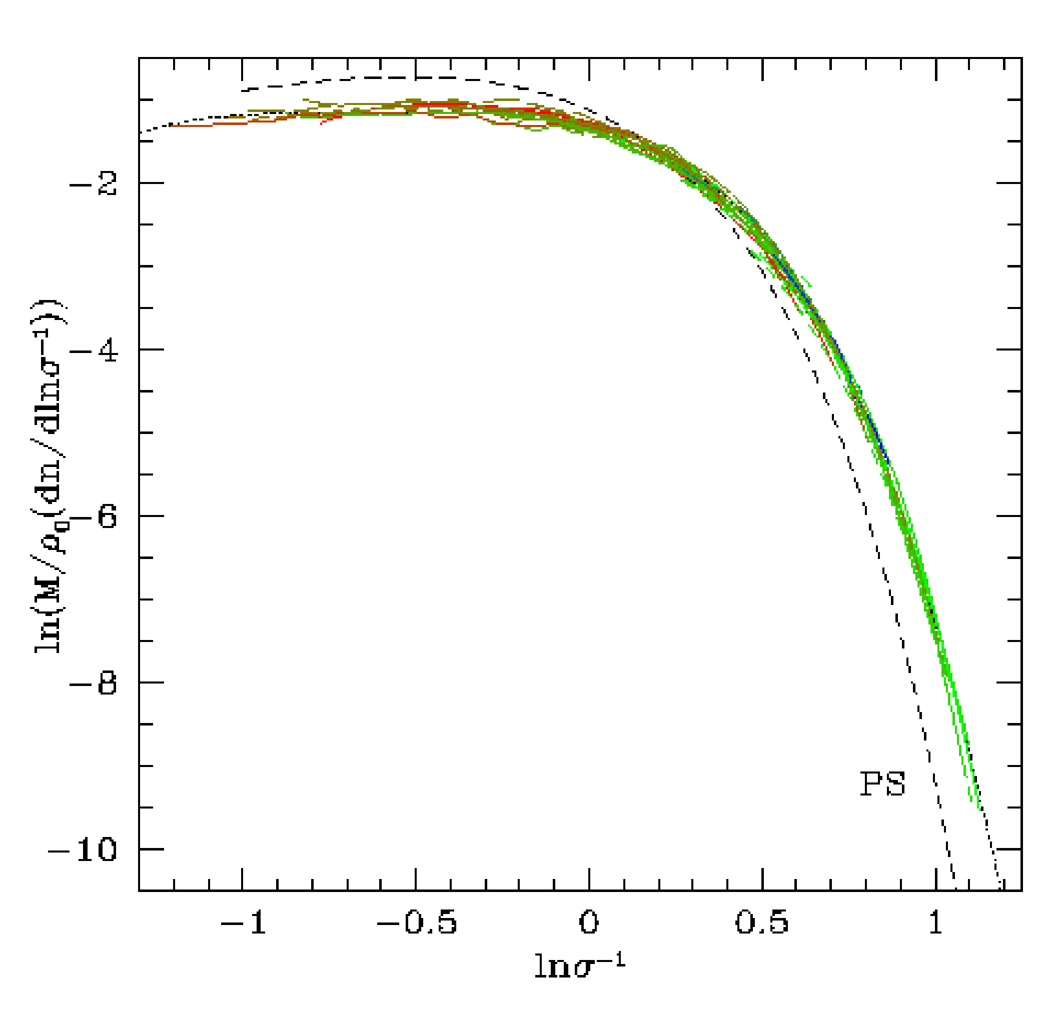
Sheth, Mo, Tormen 2001 MNRAS, 323 1

TESTING THE MASS FUNCTION



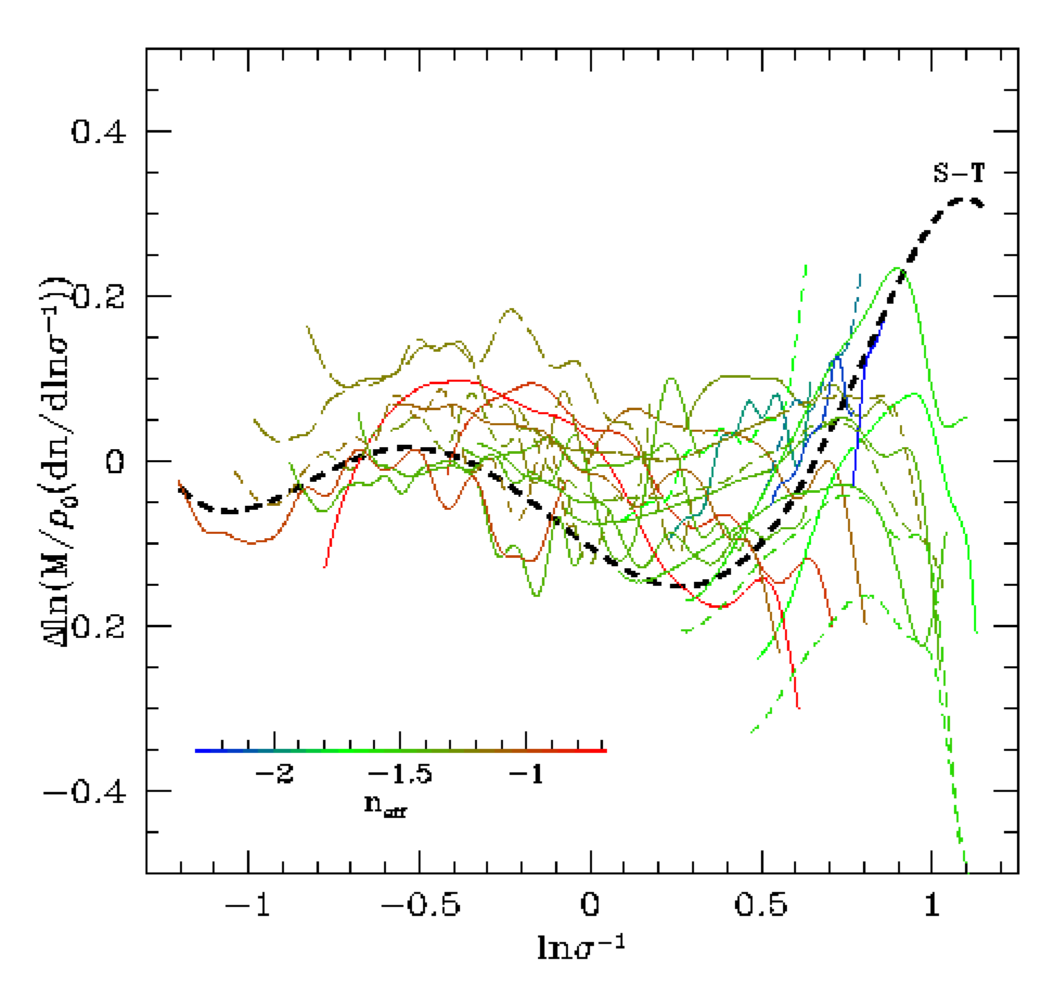
Borgani et al., 2000

Checking N(M)



Jenkins et al., 2001 MNRAS, 321, 372

Checking N(M) (2)



Jenkins et al., 2001 MNRAS, 321, 372

Conclusion

Reasonable description of the mass function in numerical simulations...