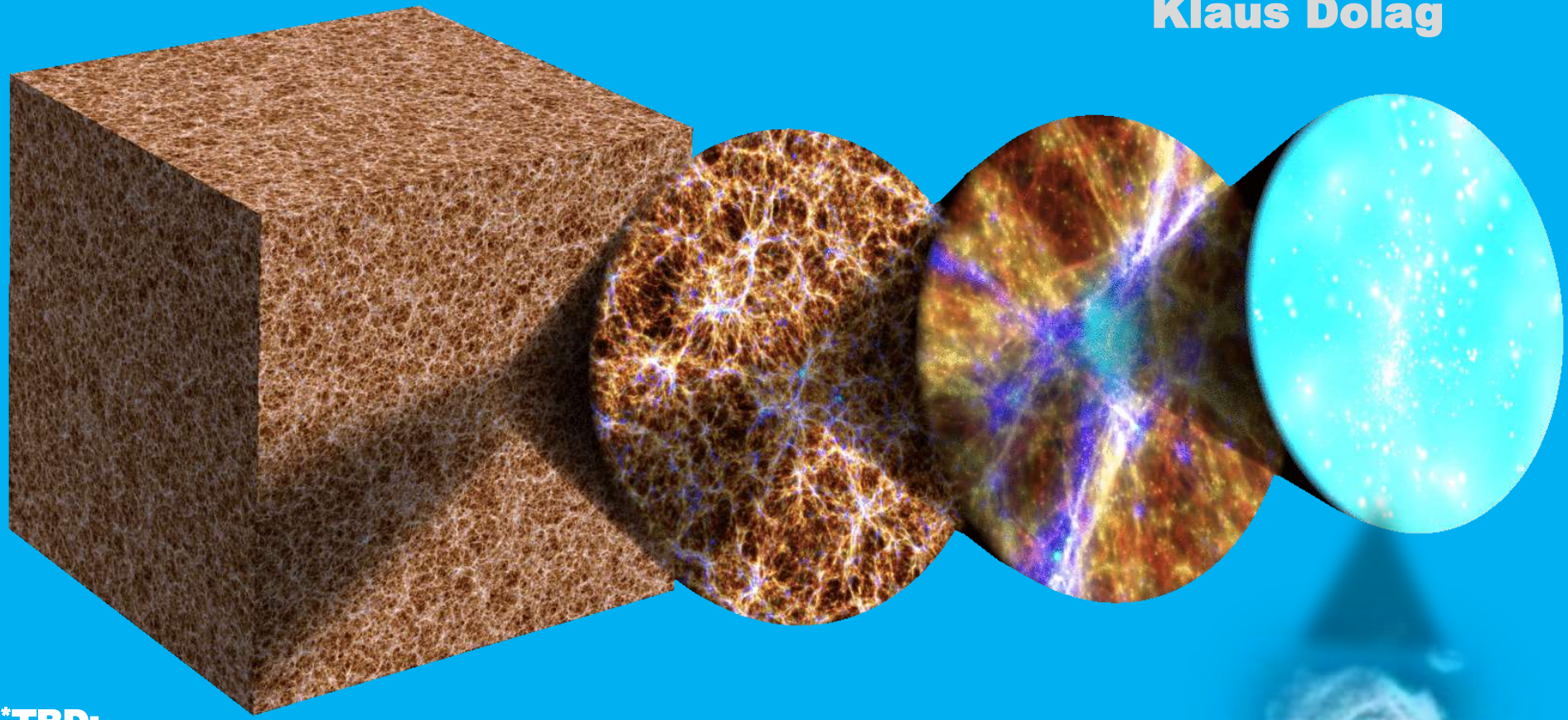
TBD*

Klaus Dolag



*TBD:

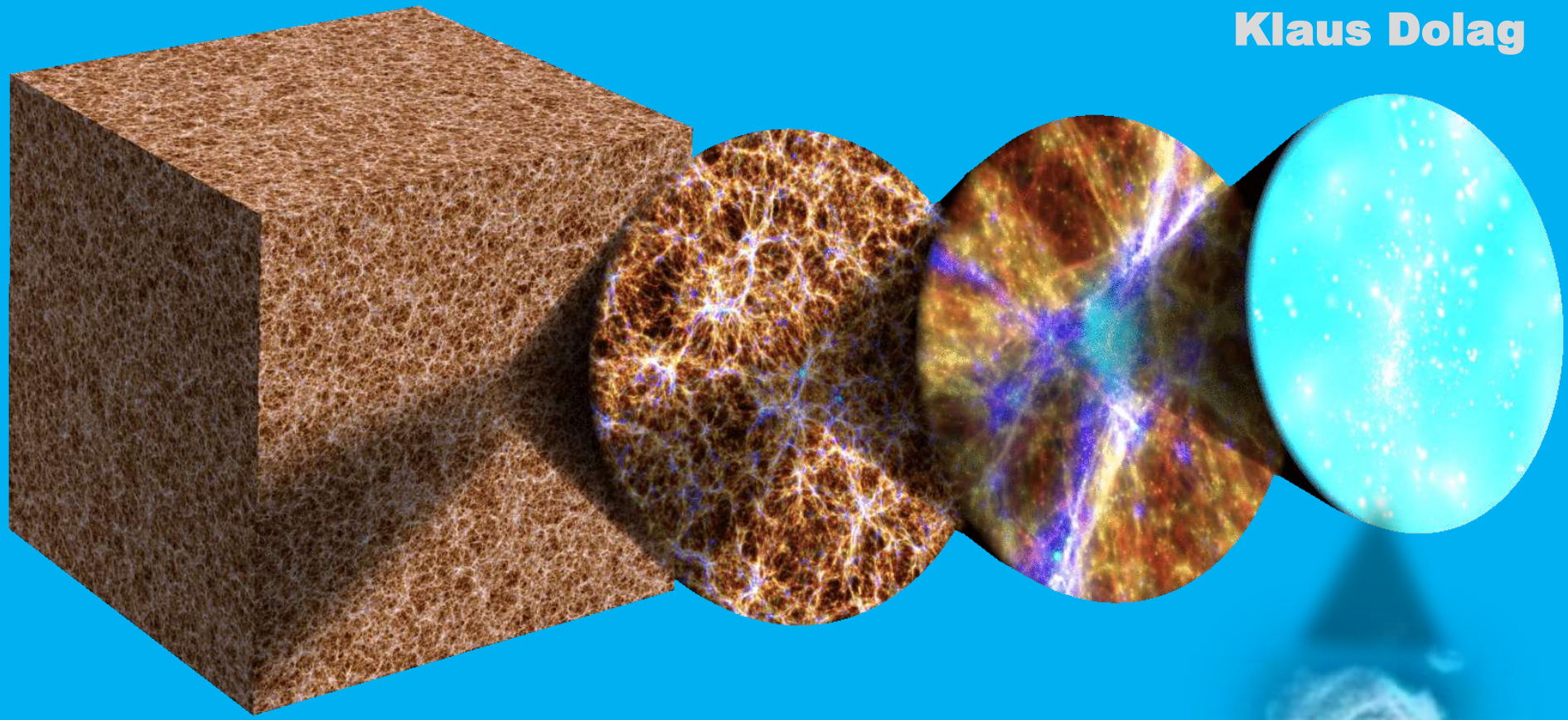
Something

- to be done – noch zu erledigen
- to be defined – noch zu definieren
- to be decided – noch zu entscheiden
- to be discussed – noch zu diskutieren
- to be determined – noch zu bestimmen

Tremendous Boxes Deciphered

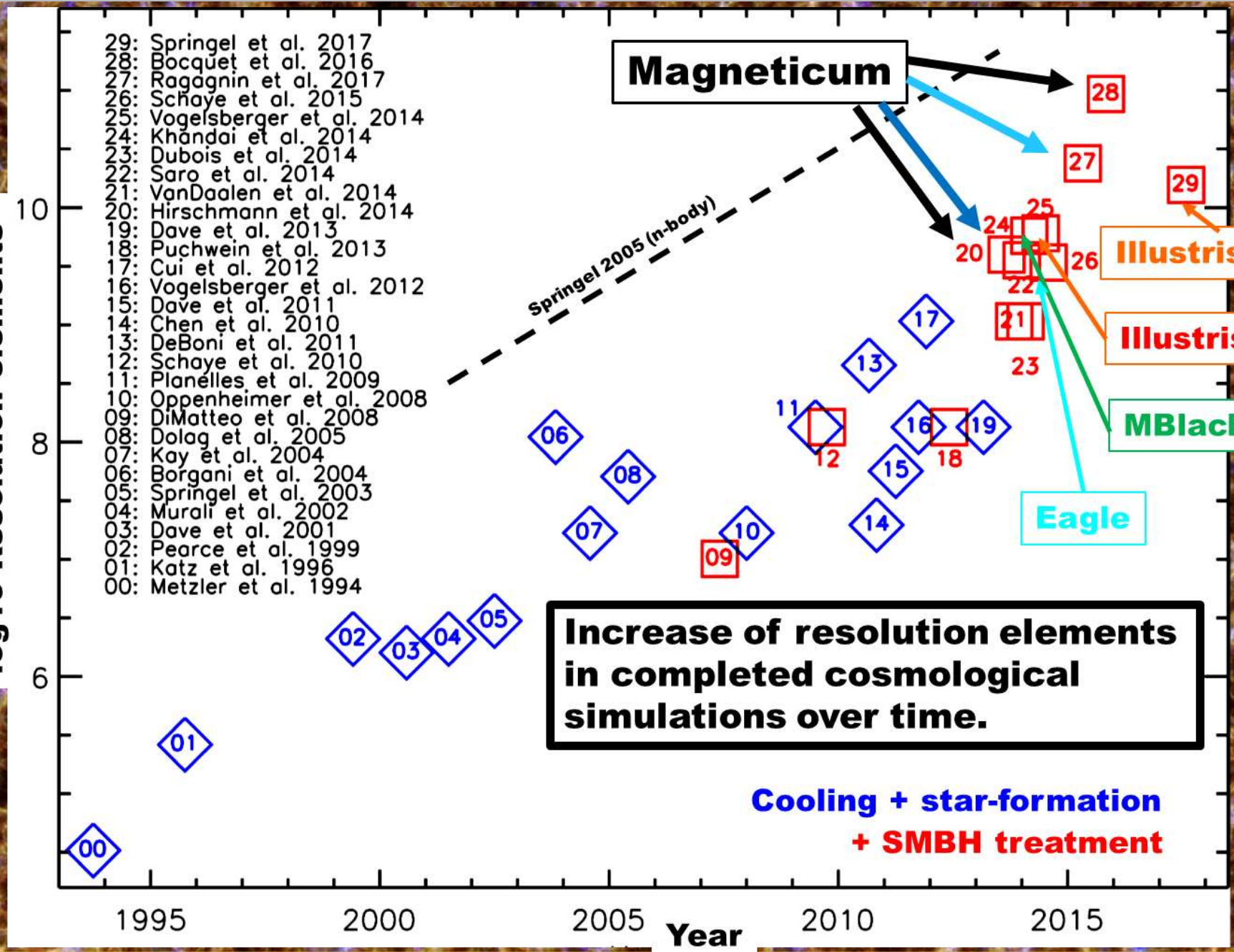
From Cluster Physics to Cosmology

Klaus Dolag

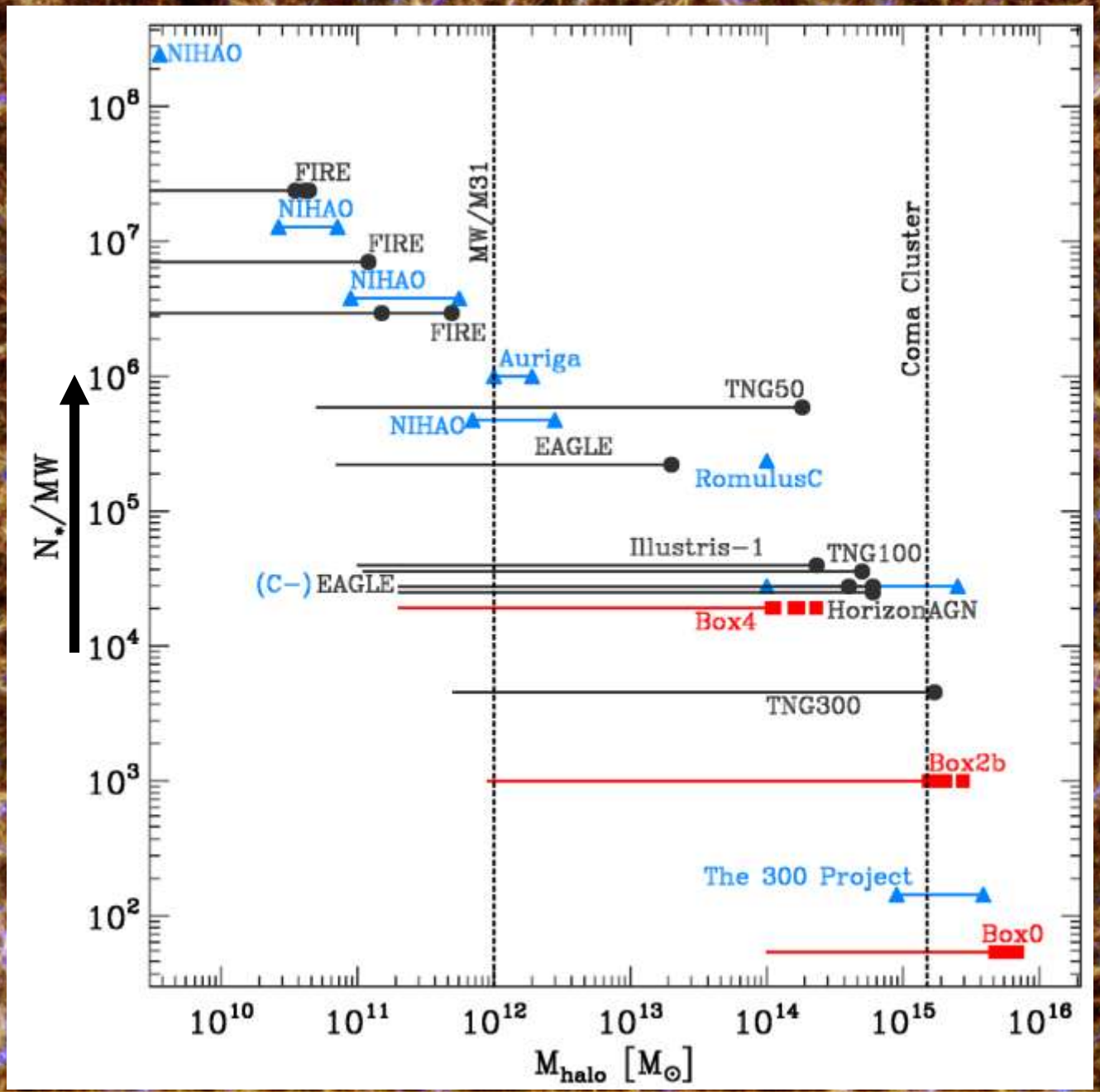


V. Biffi, J. Hinz, M. Lotz, N. Lyskova, A. Saro, P. Singh

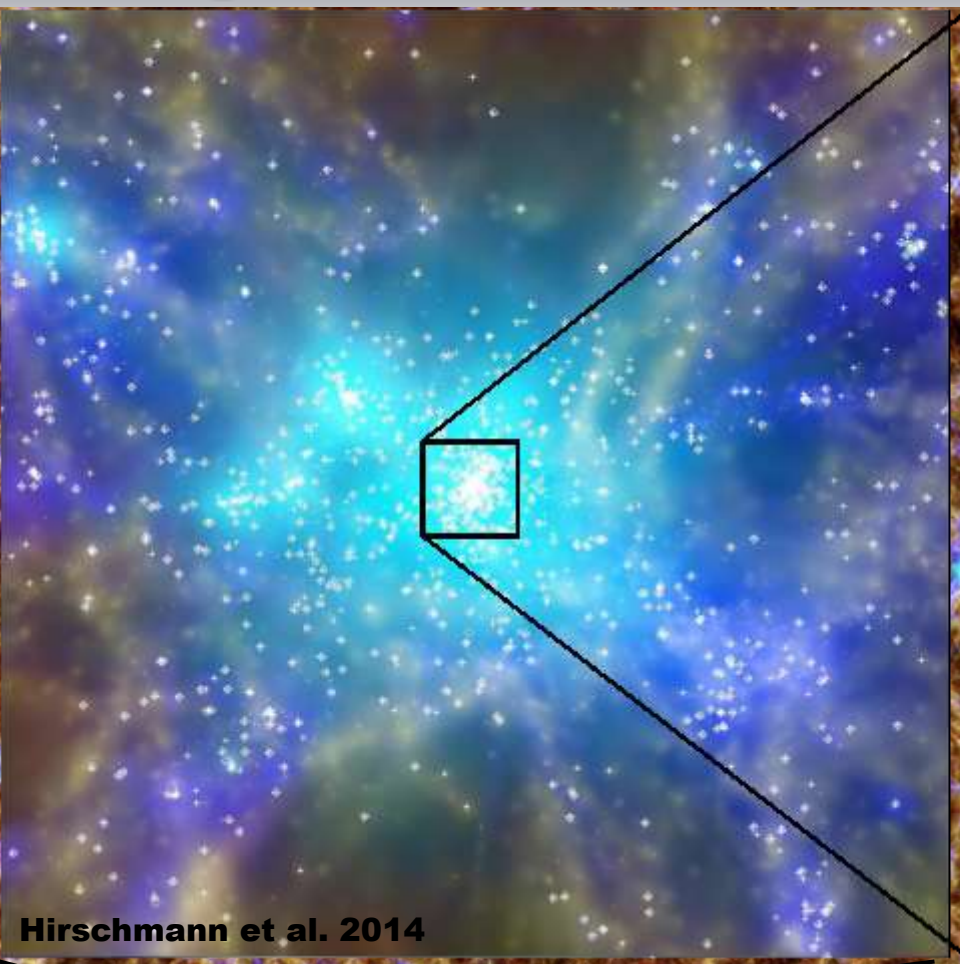
Simulation Summary (I)

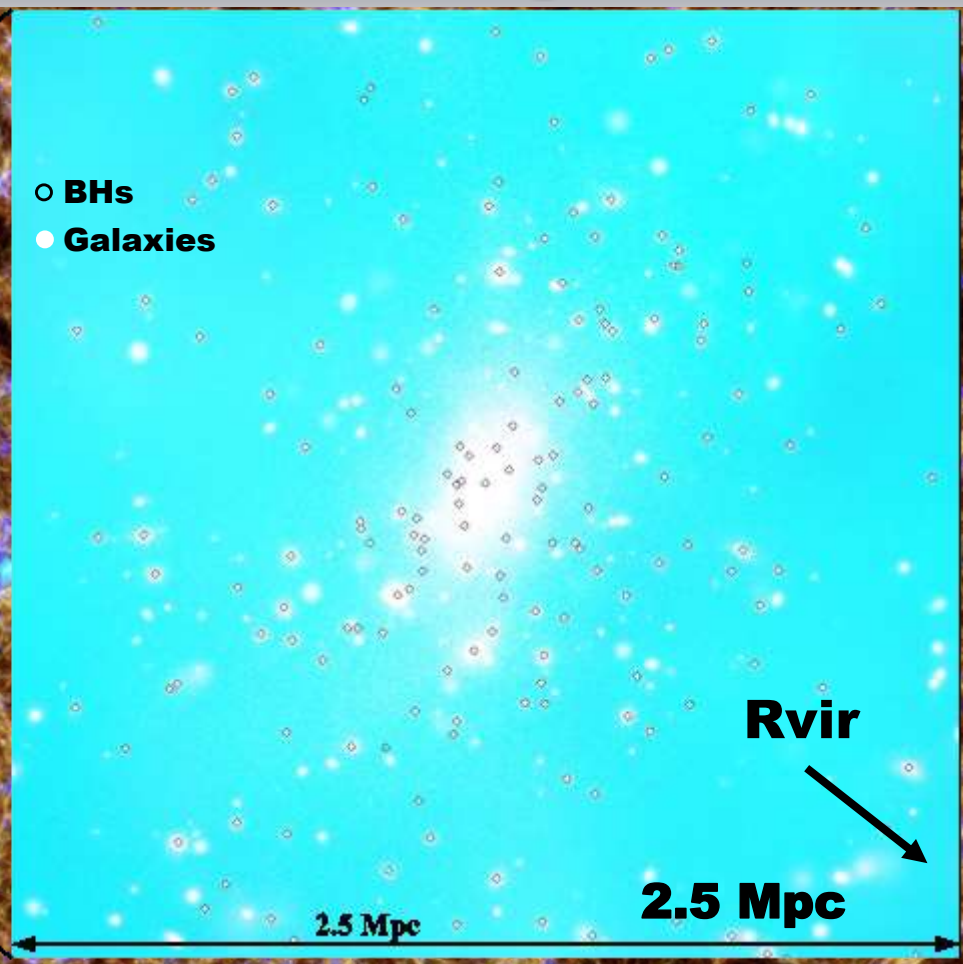


Simulation Summary (II)



Large Simulations: Connecting Scales

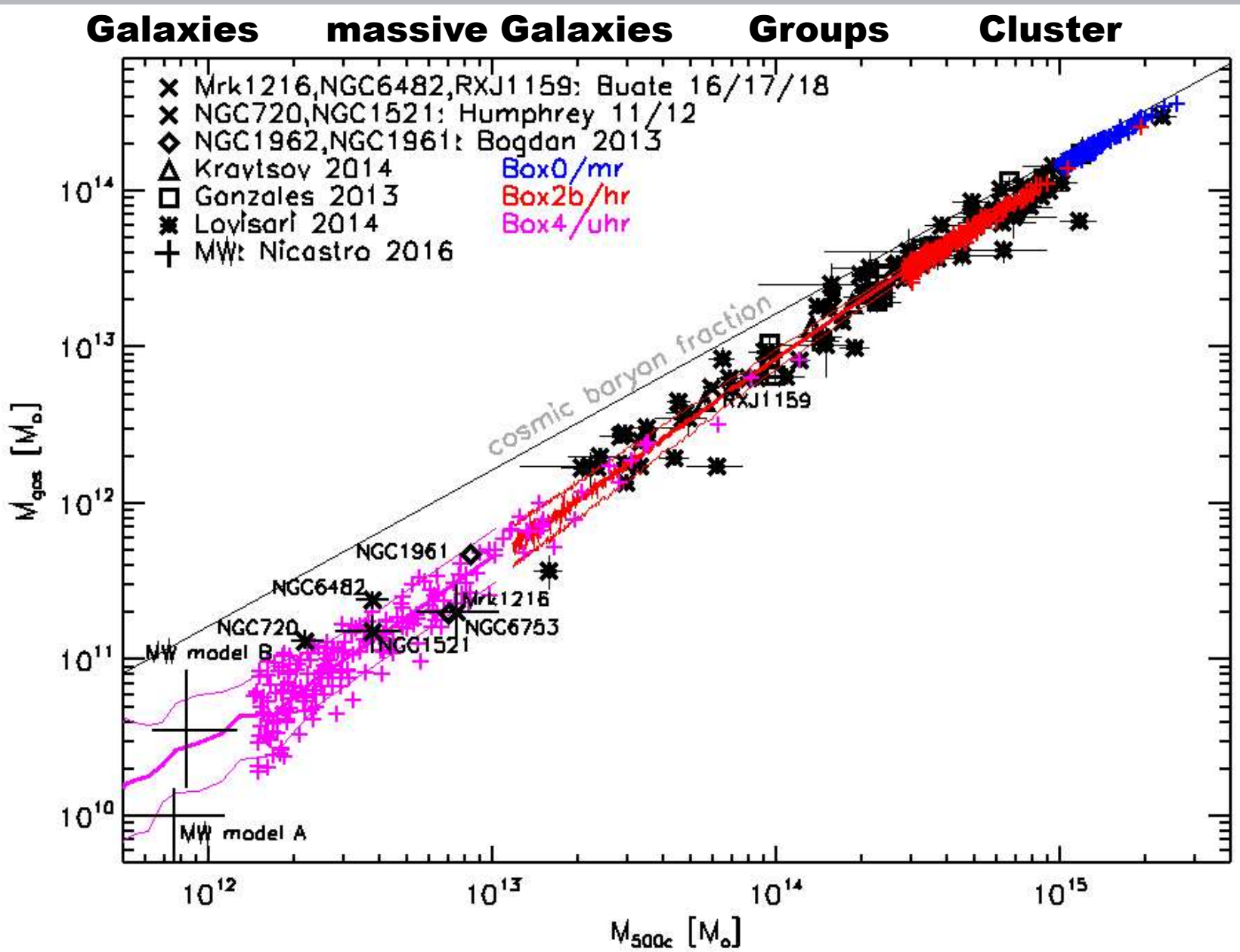




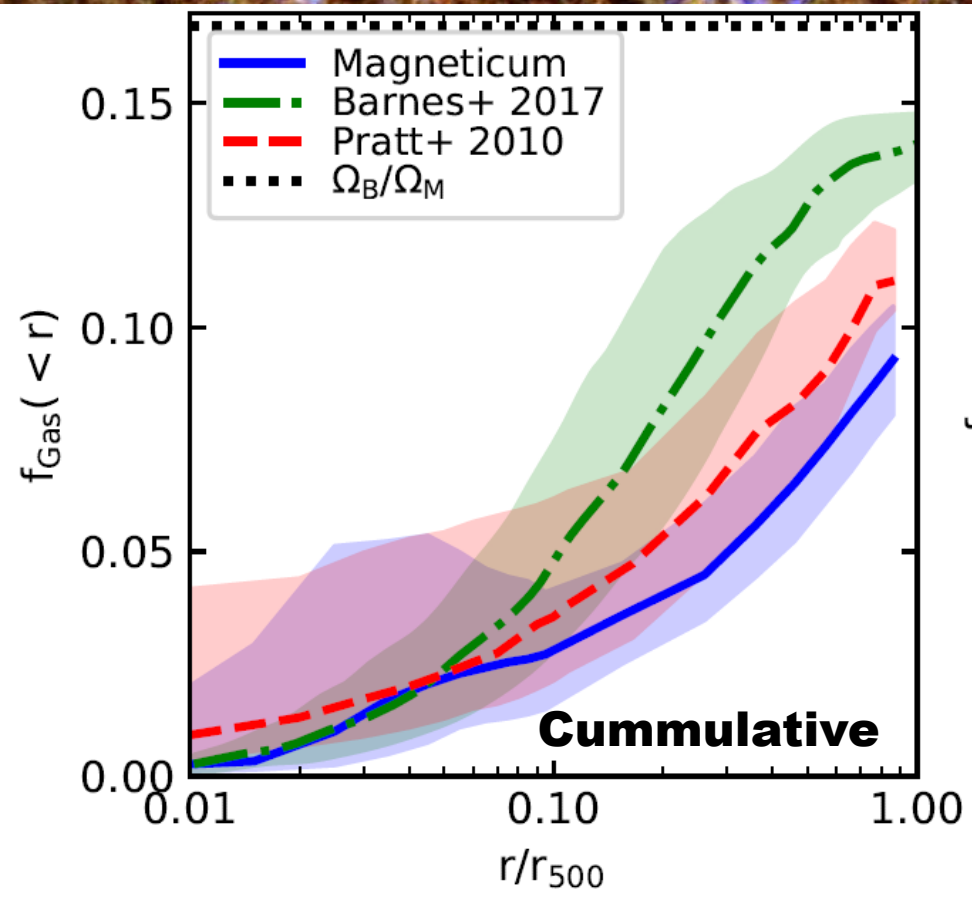
- Growth of halos
- Physics in the core
- Connecting AGN

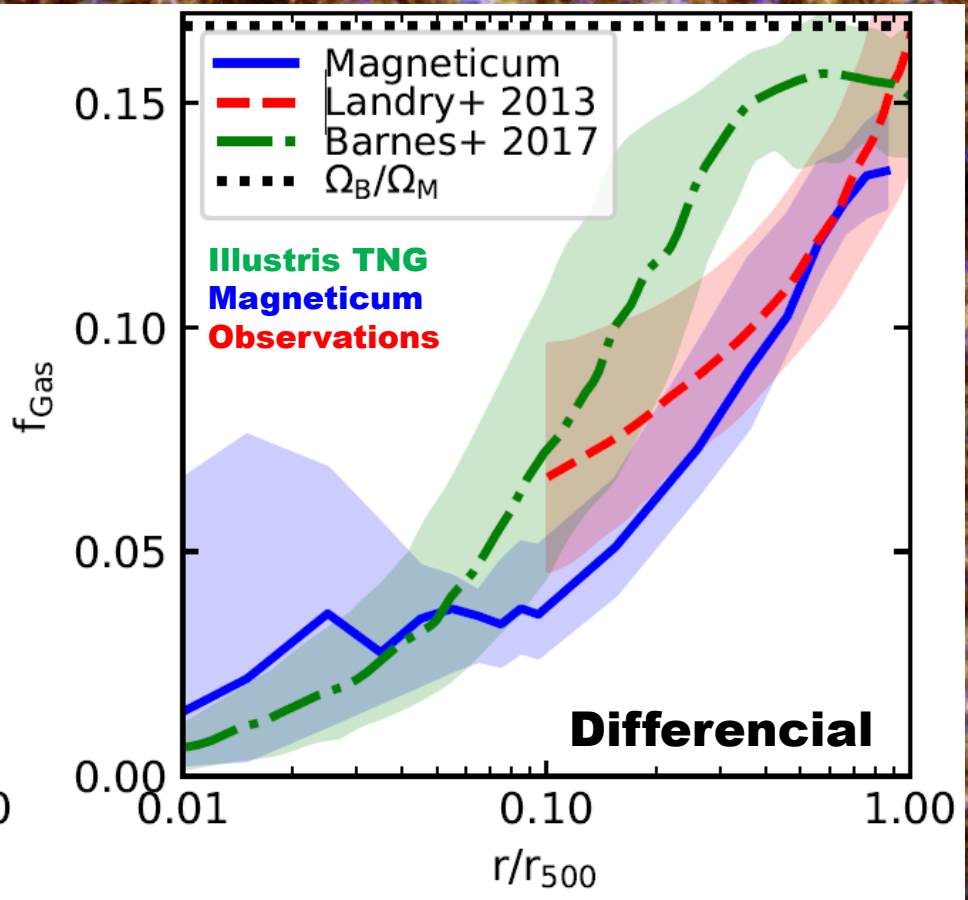
900 Mpc

The Hot Gas reservoir of Halos ...



… and the shape of radial profiles !





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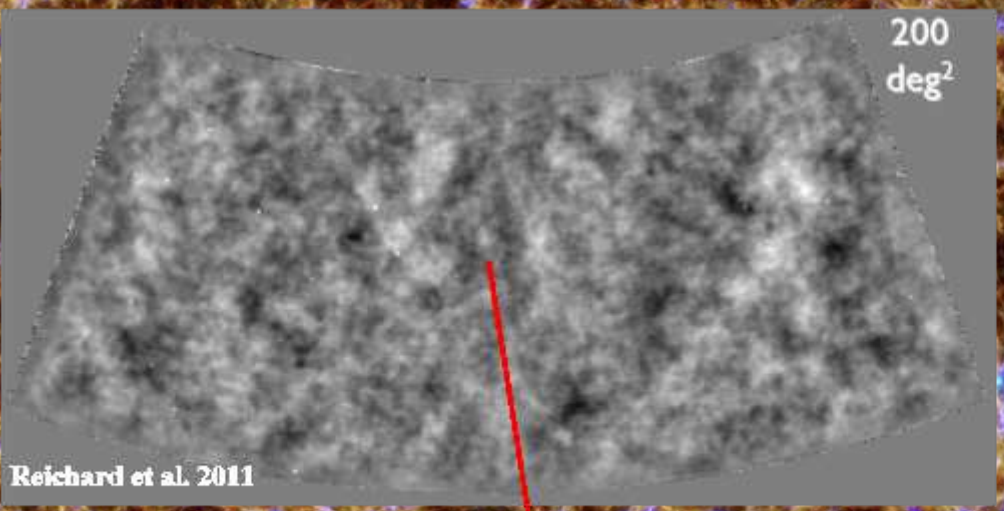
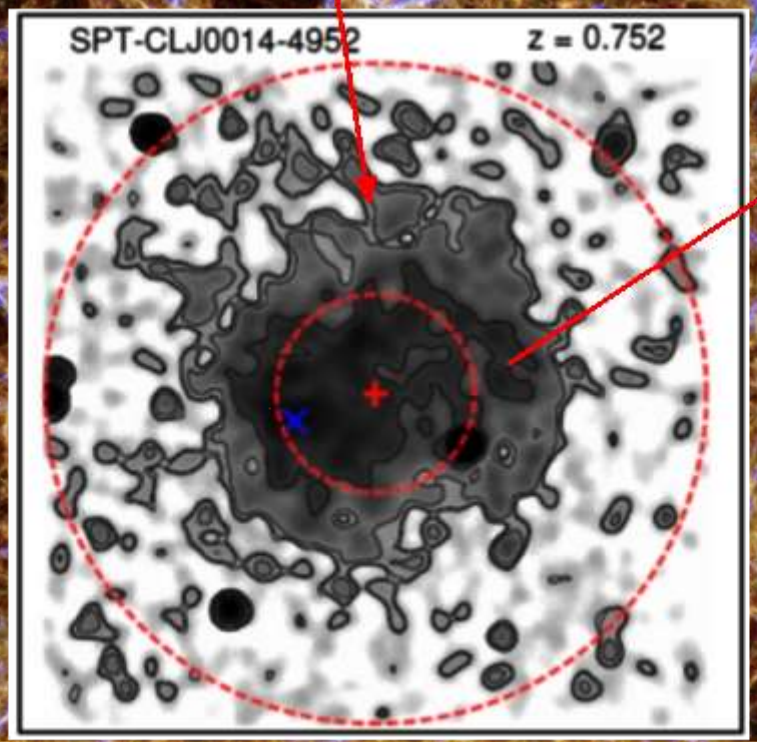
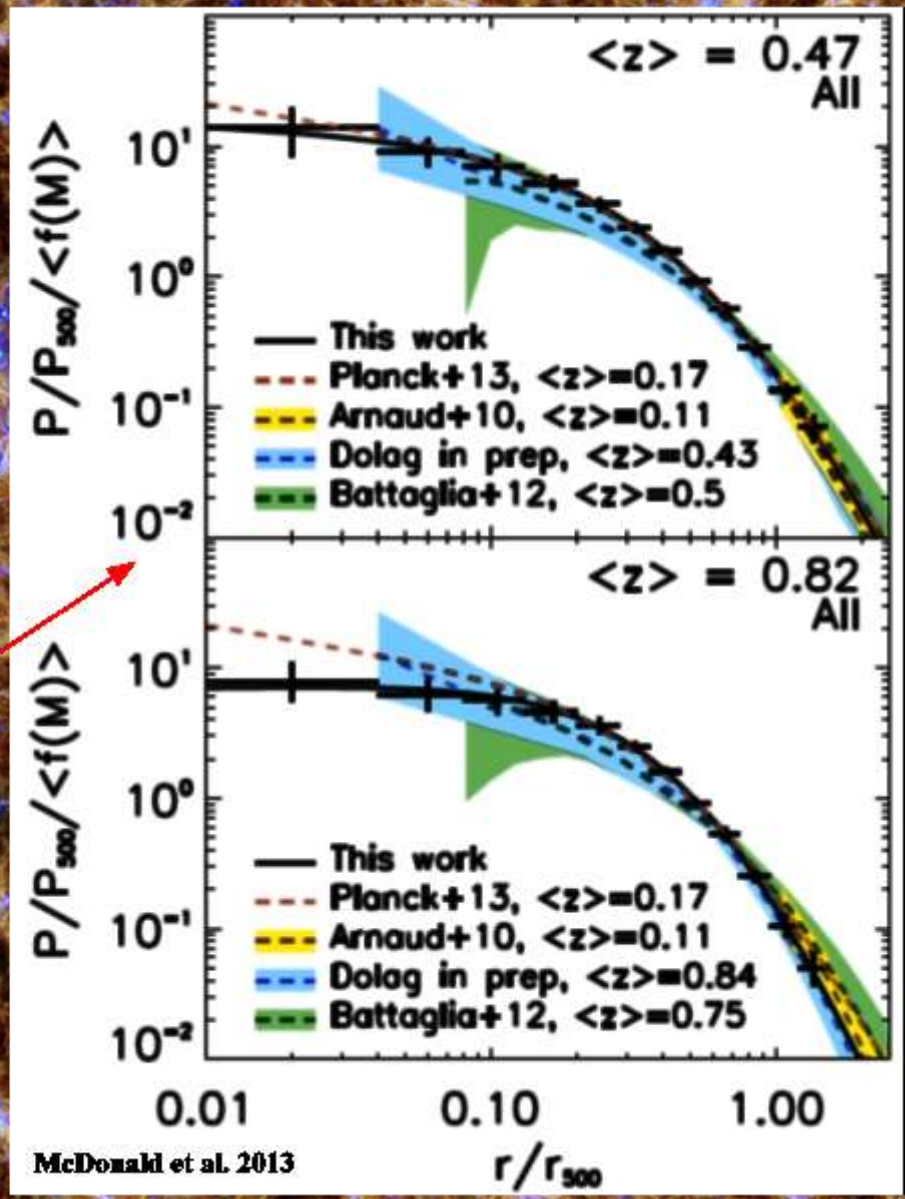
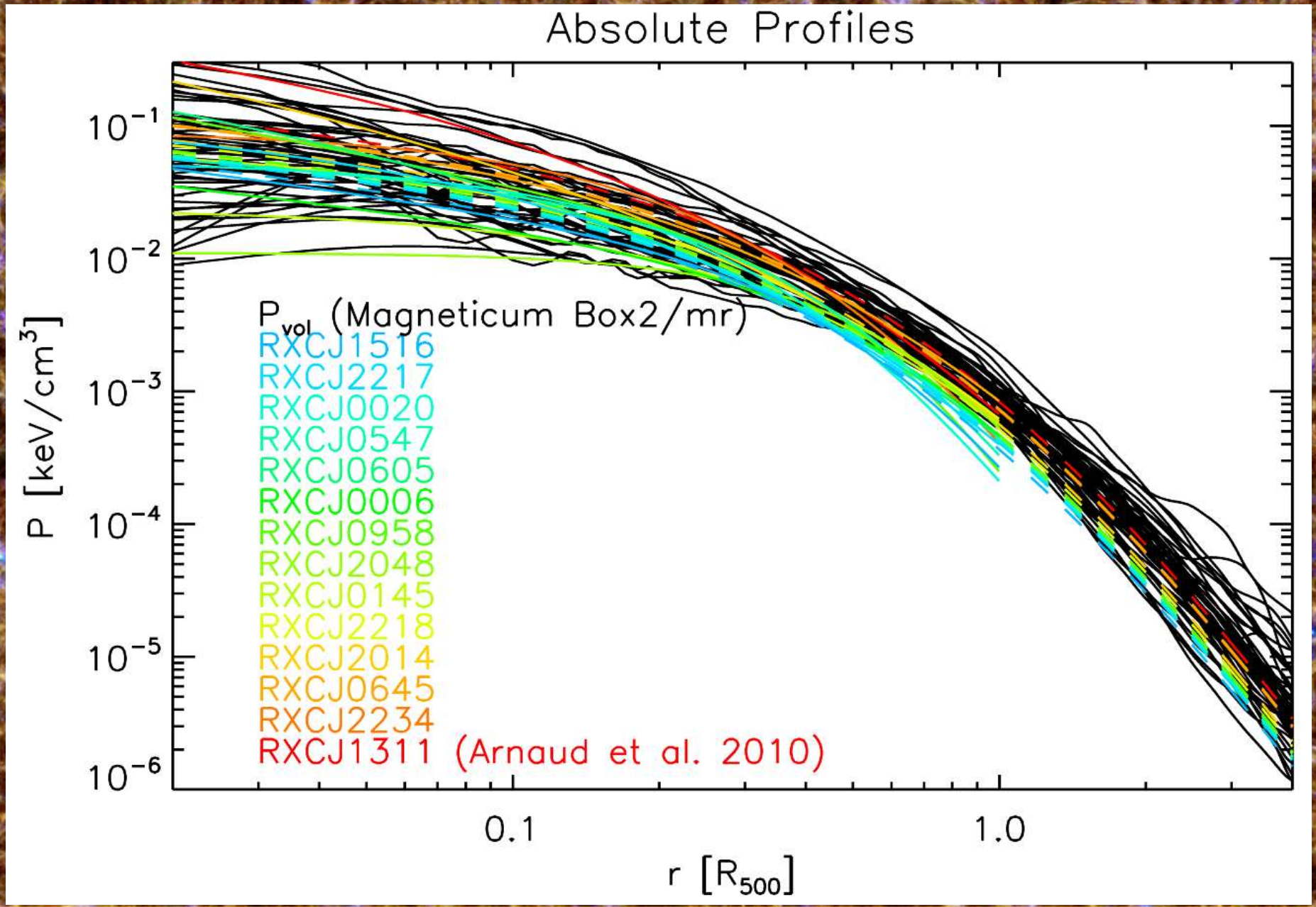
Presssure profiles of clusters ...



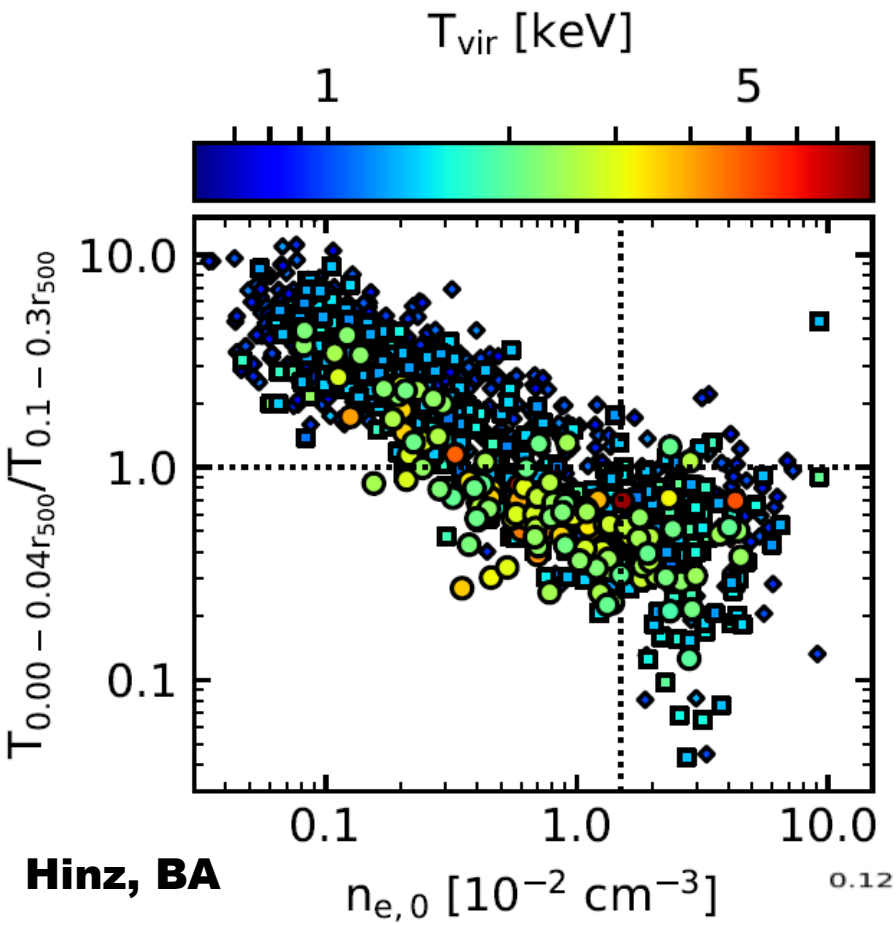




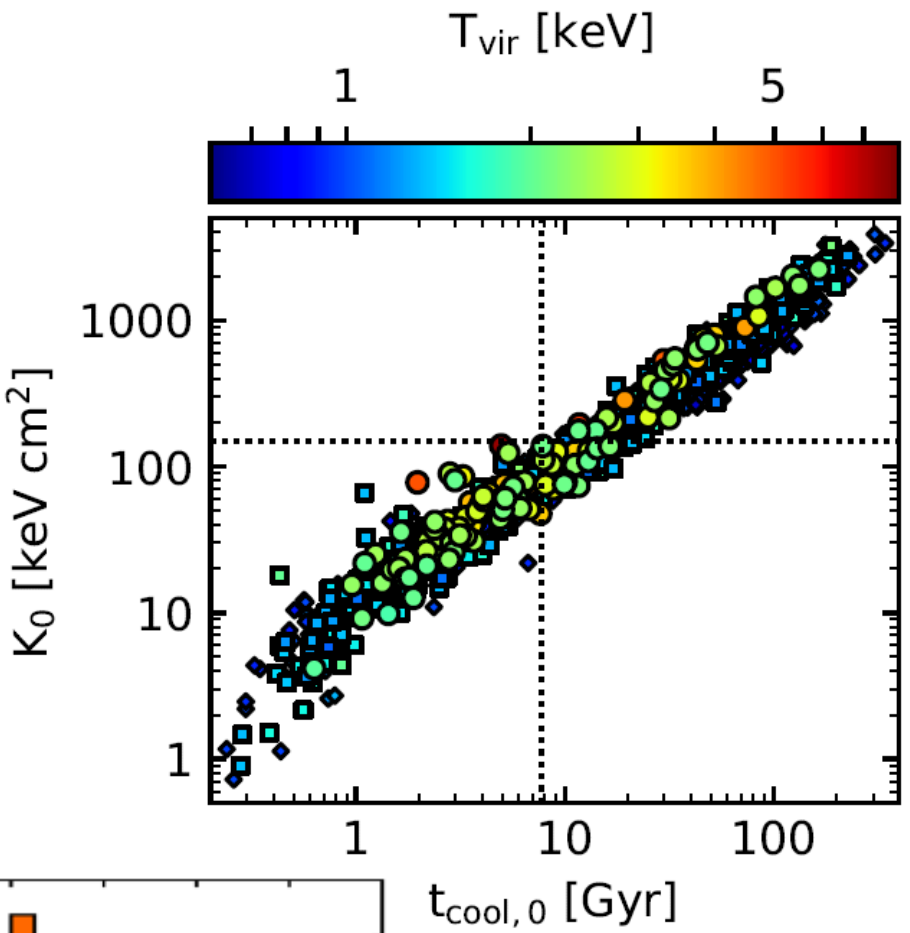
… and their scatter !

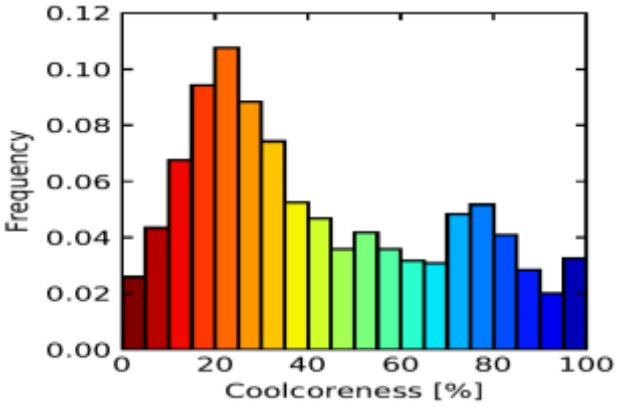


CC and non CC Clusters



Hinz, BA

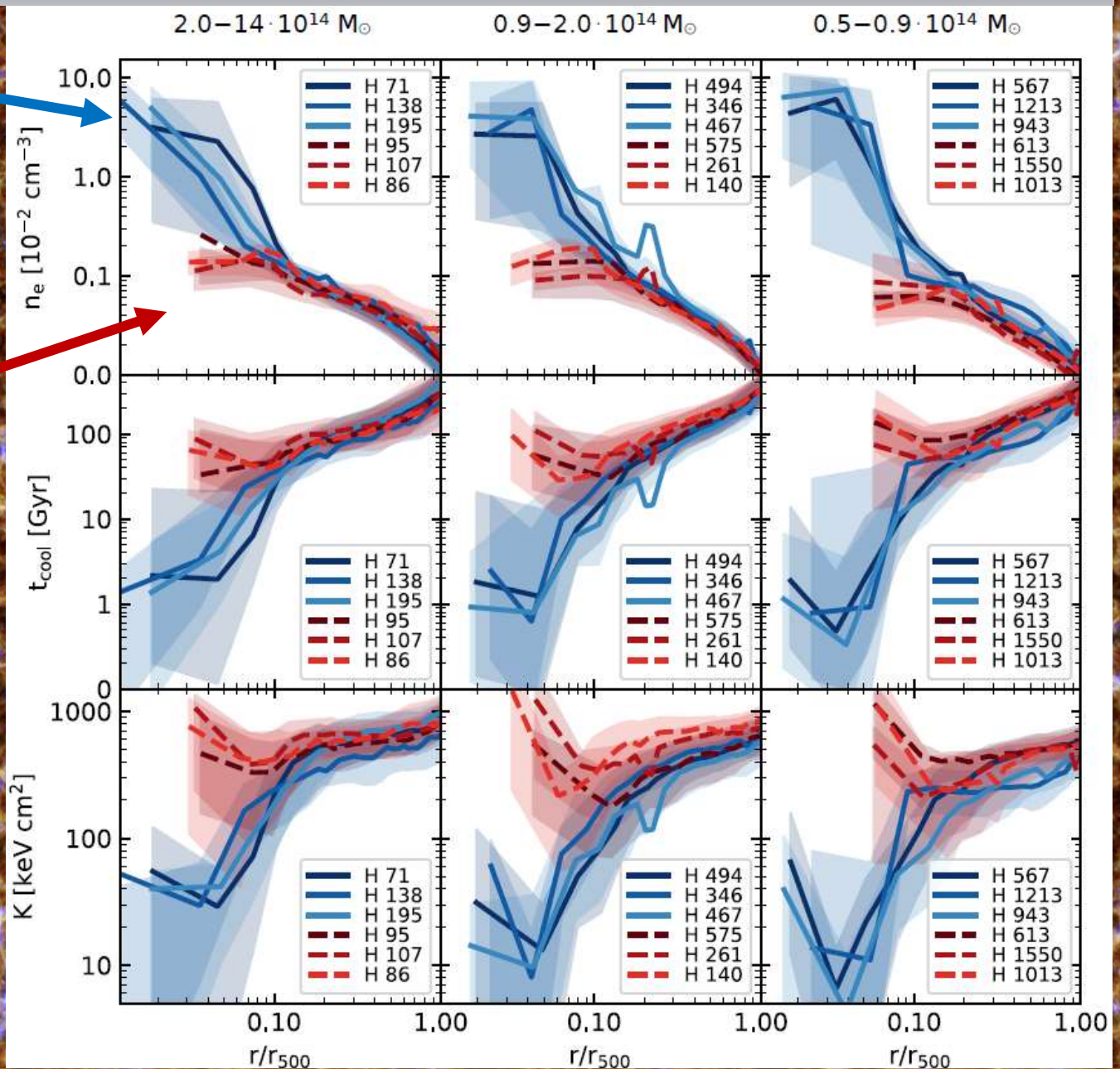




CC / nCC: detailed interplay between AGN and heat transport, see Rasia+ 2015

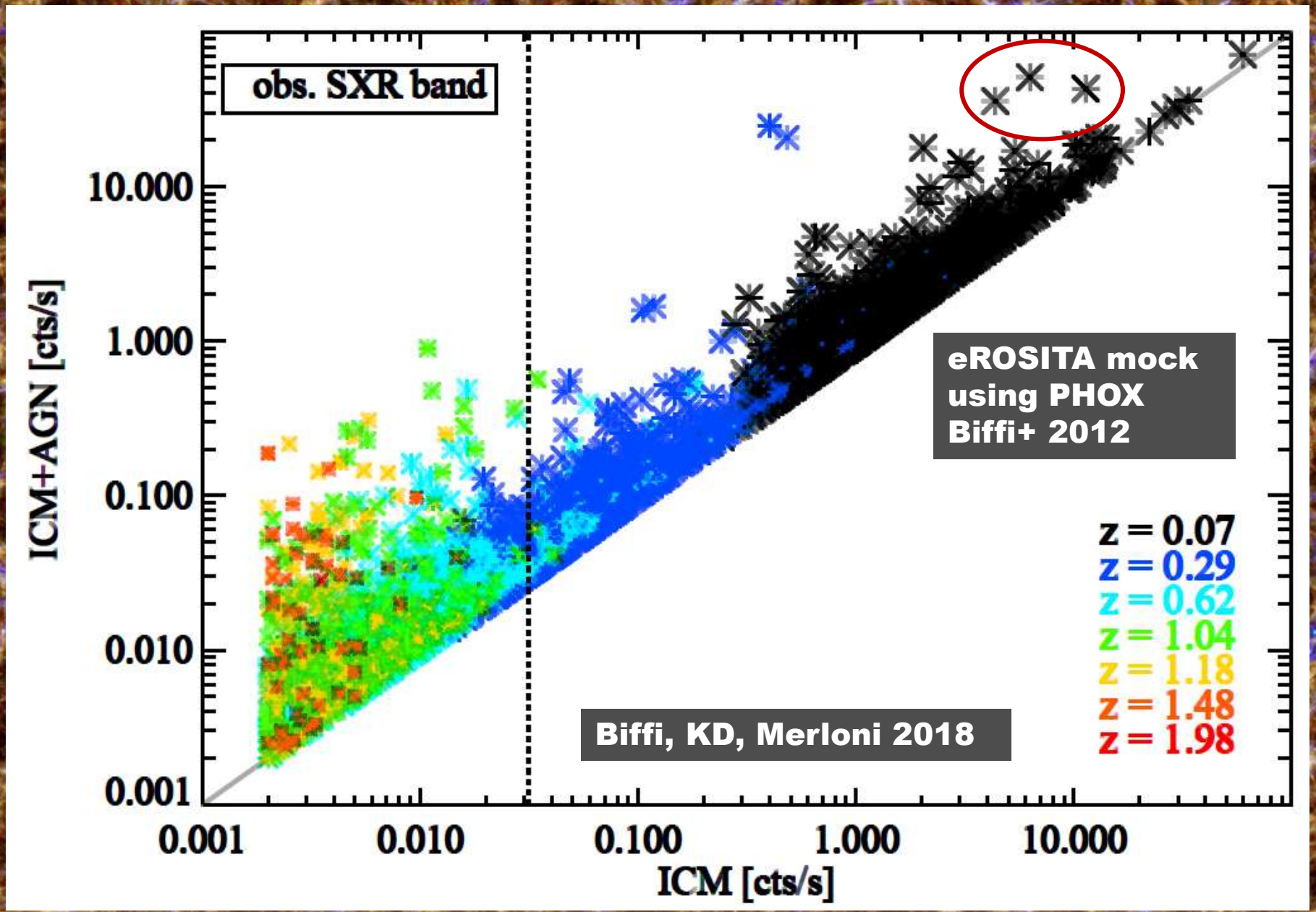
(but also Arth+ 2014, Barnes+ 2018/2019)

Cores: CC and nonCC Clusters

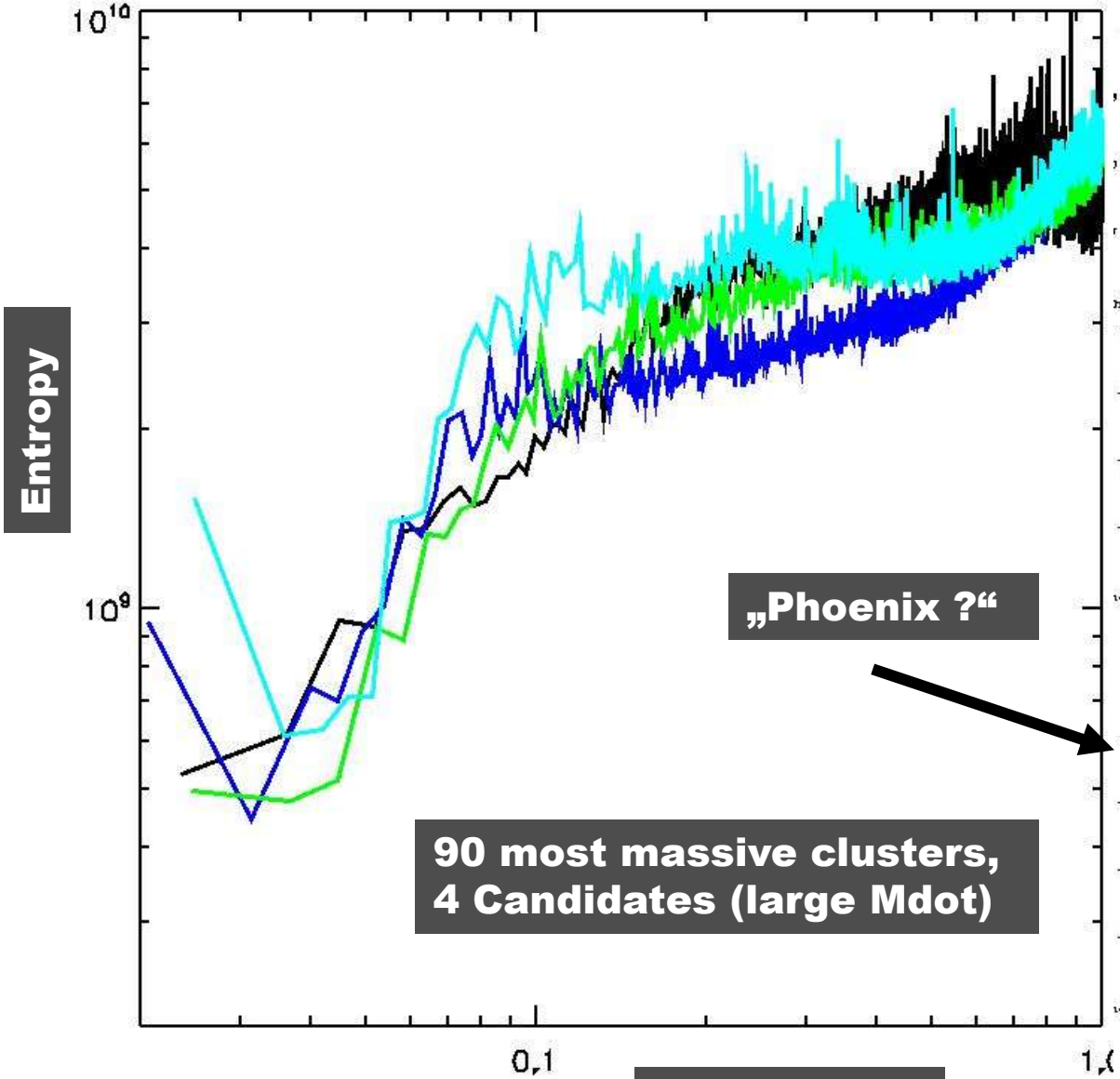


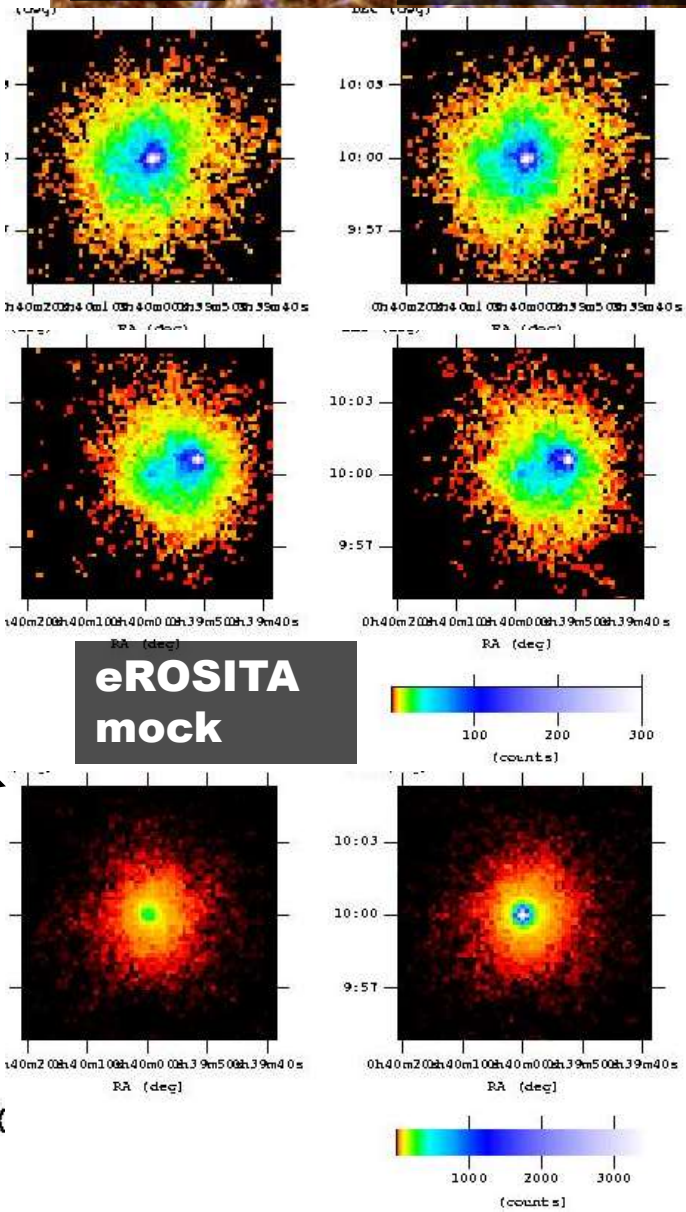
Hinz, BA

X-Ray Emission: ICM vs. AGN

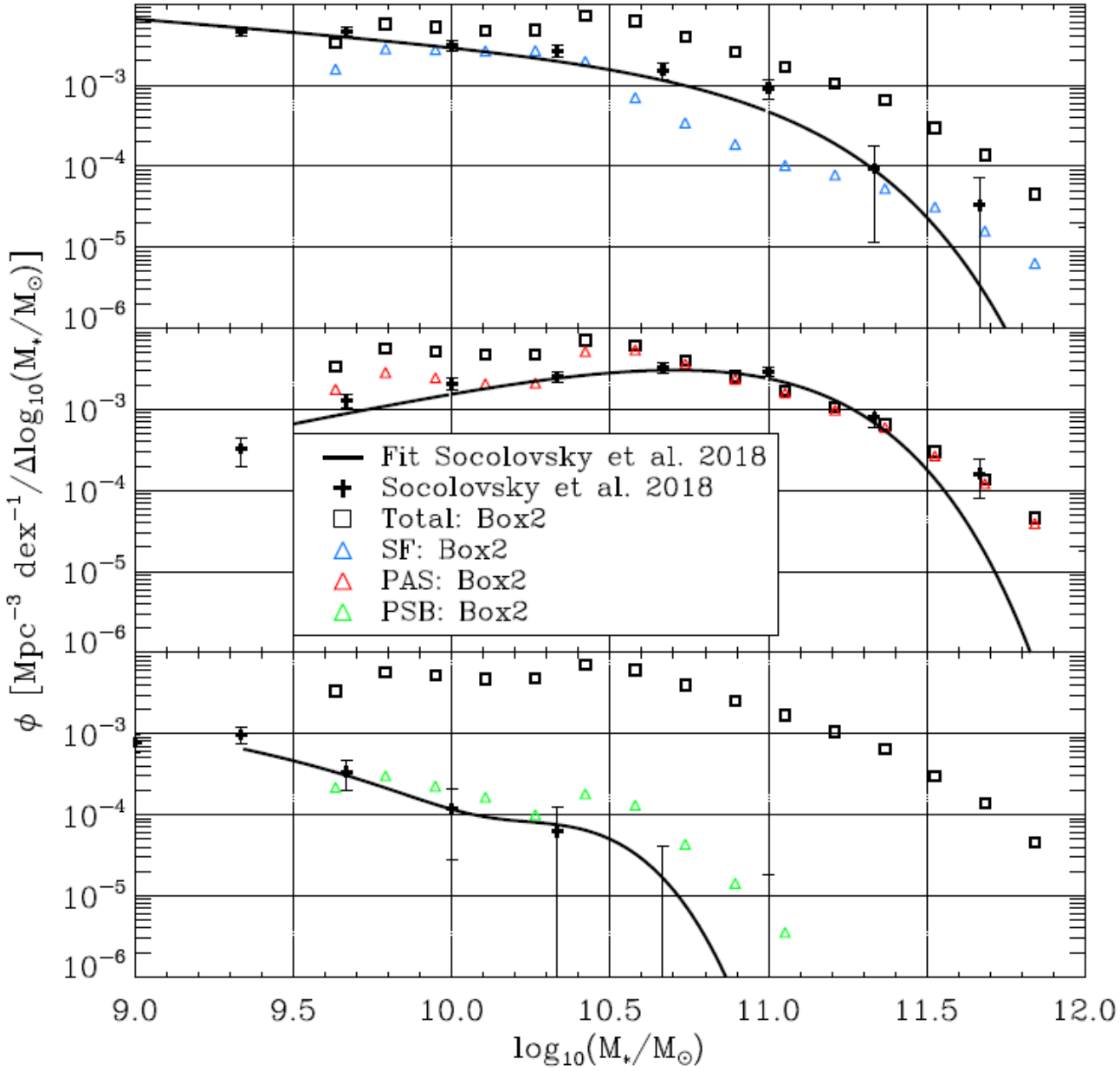


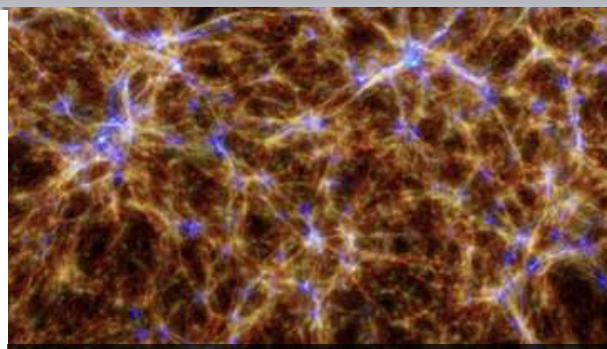
Finding a „Phoenix“ Cluster





Realistic Galaxy population in Clusters?

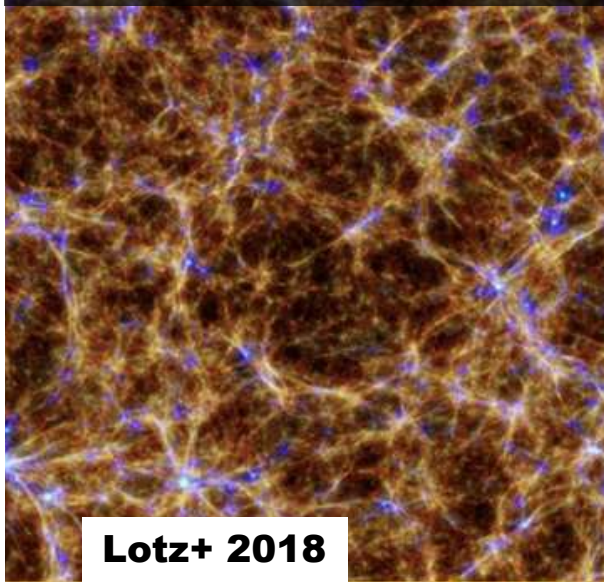




Dividing Galaxies in SF, PAS and PSB:

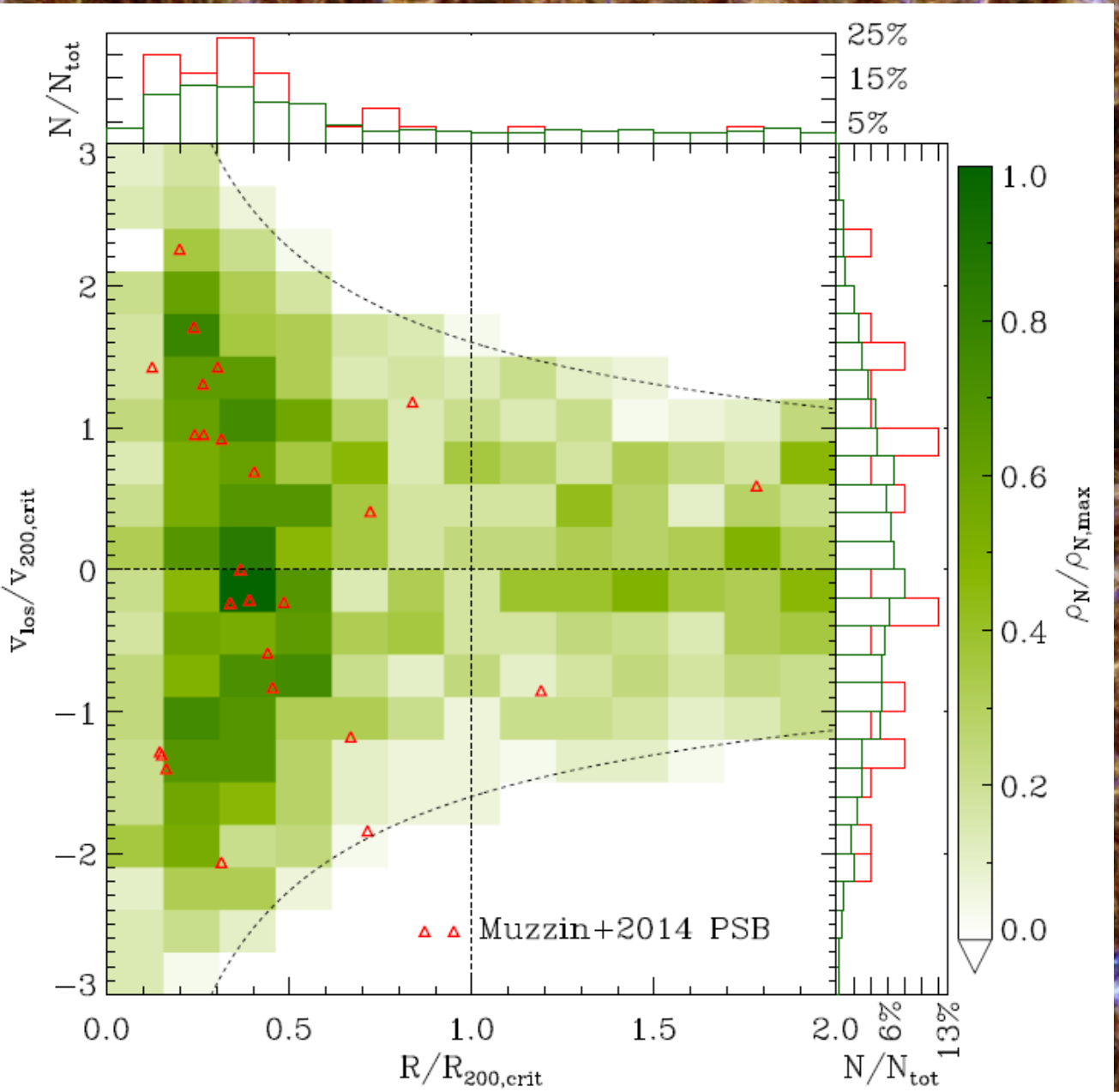
PSBs:

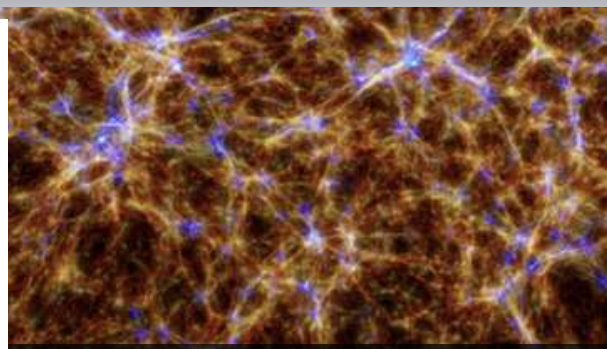
- **>2% M*(t<0.5 Gyr)**
- **SSFR * t_H < 0.1**



Lotz+ 2018

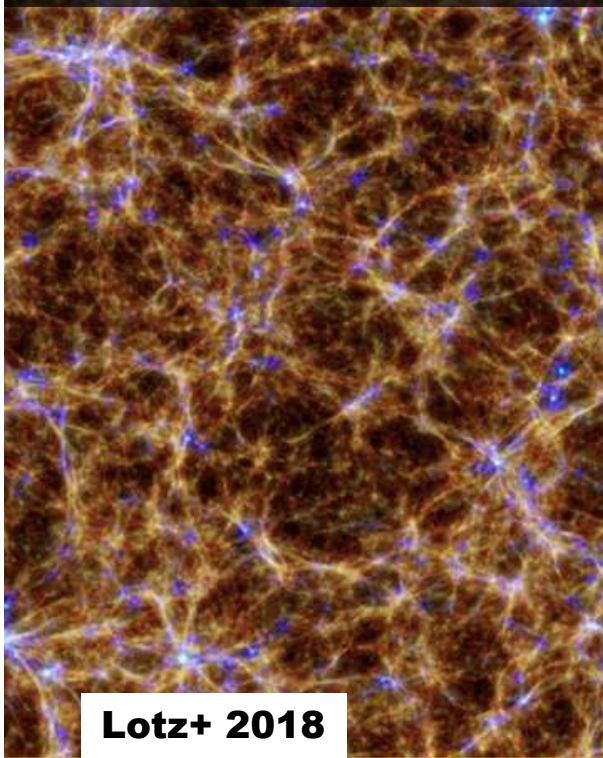
Interaction of Galaxies with ICM





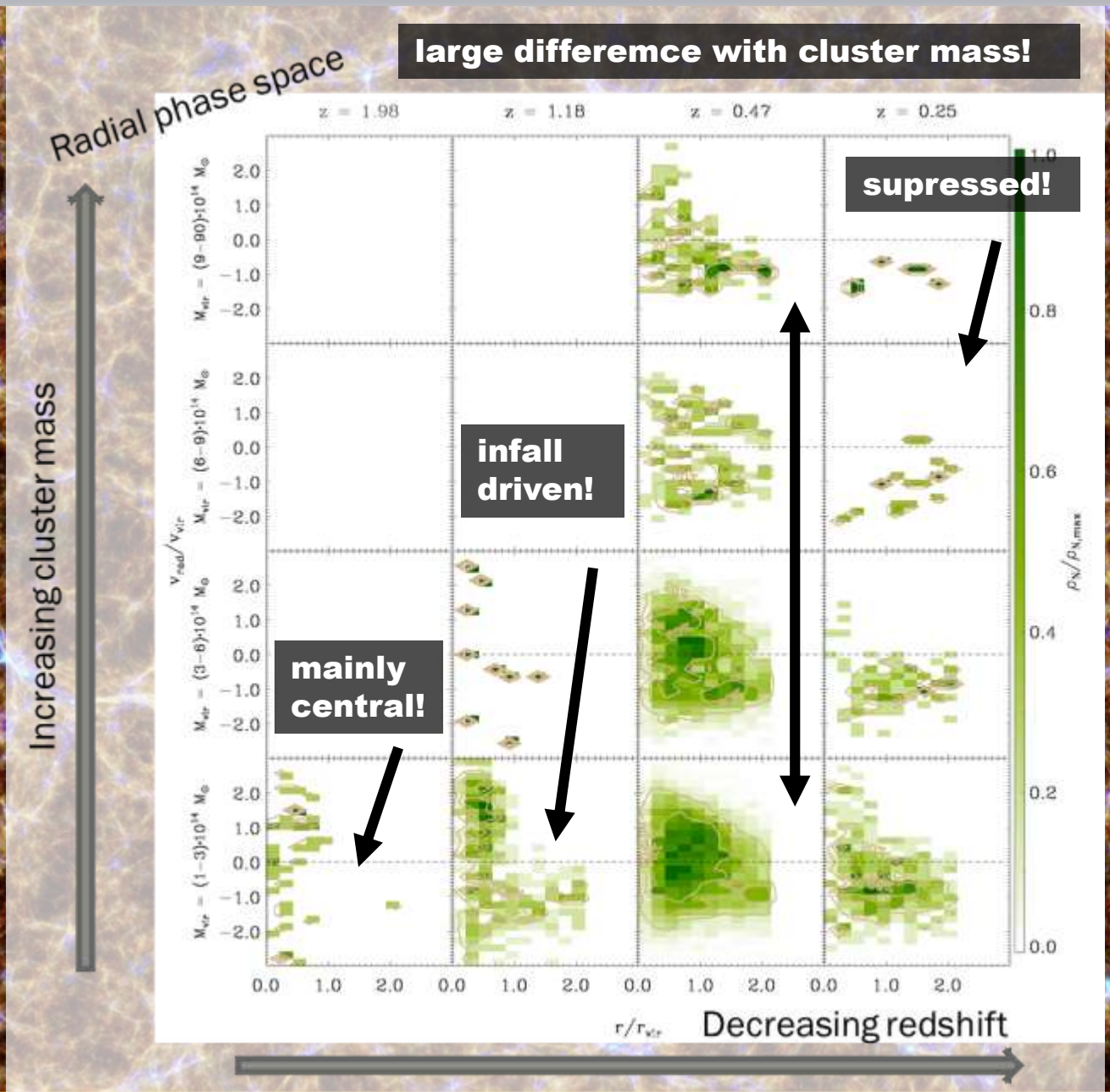
PSBs:

- **>2% M*(t<0.5 Gyr)**
- **SSFR * t_H < 0.1**



Lotz+ 2018

Interaction of Galaxies with ICM



PSBs:

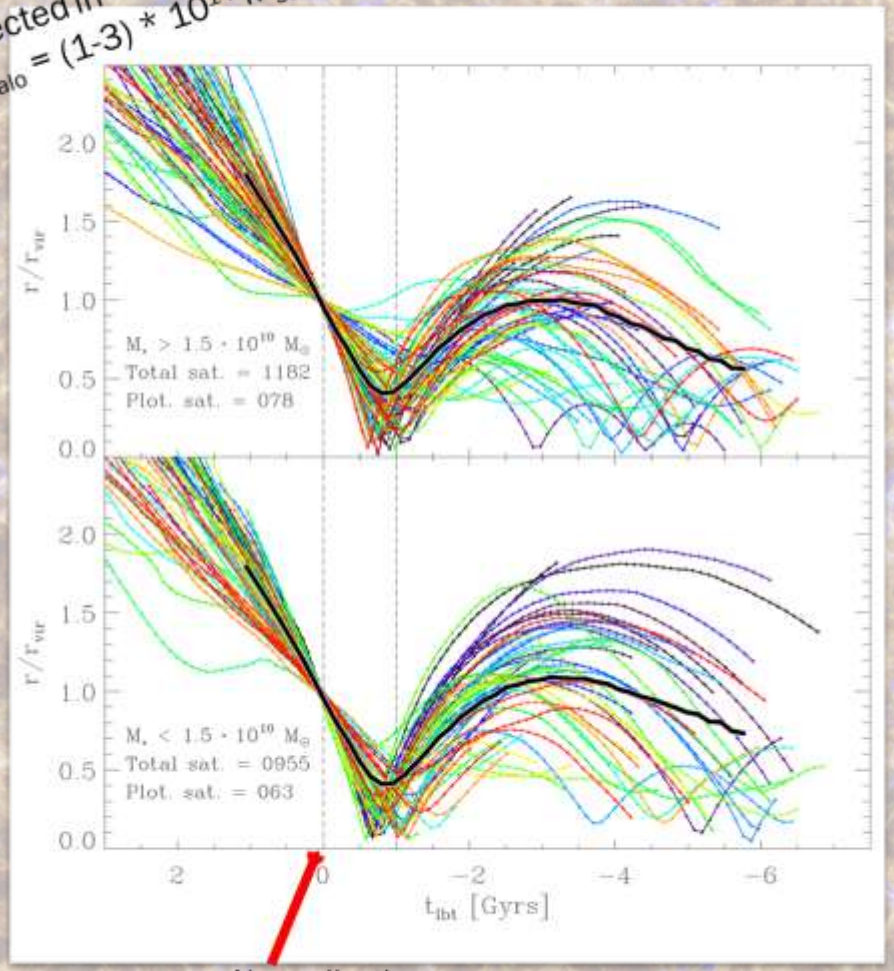
- **>2% M*(t<0.5 Gyr)**
- **SSFR * t_H < 0.1**

Evolution with Time!

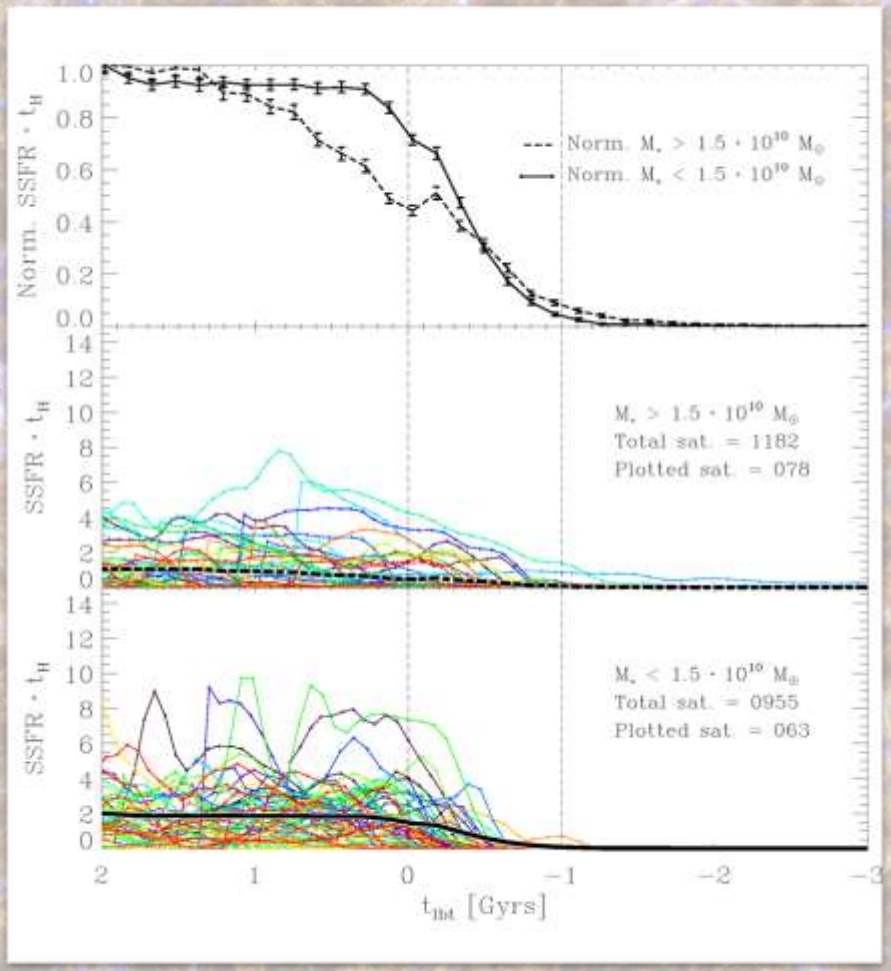
Lotz+ 2019

Survival of Galaxies

Selected in
M_{halo} = (1-3) * 10^{14} M_{sol}



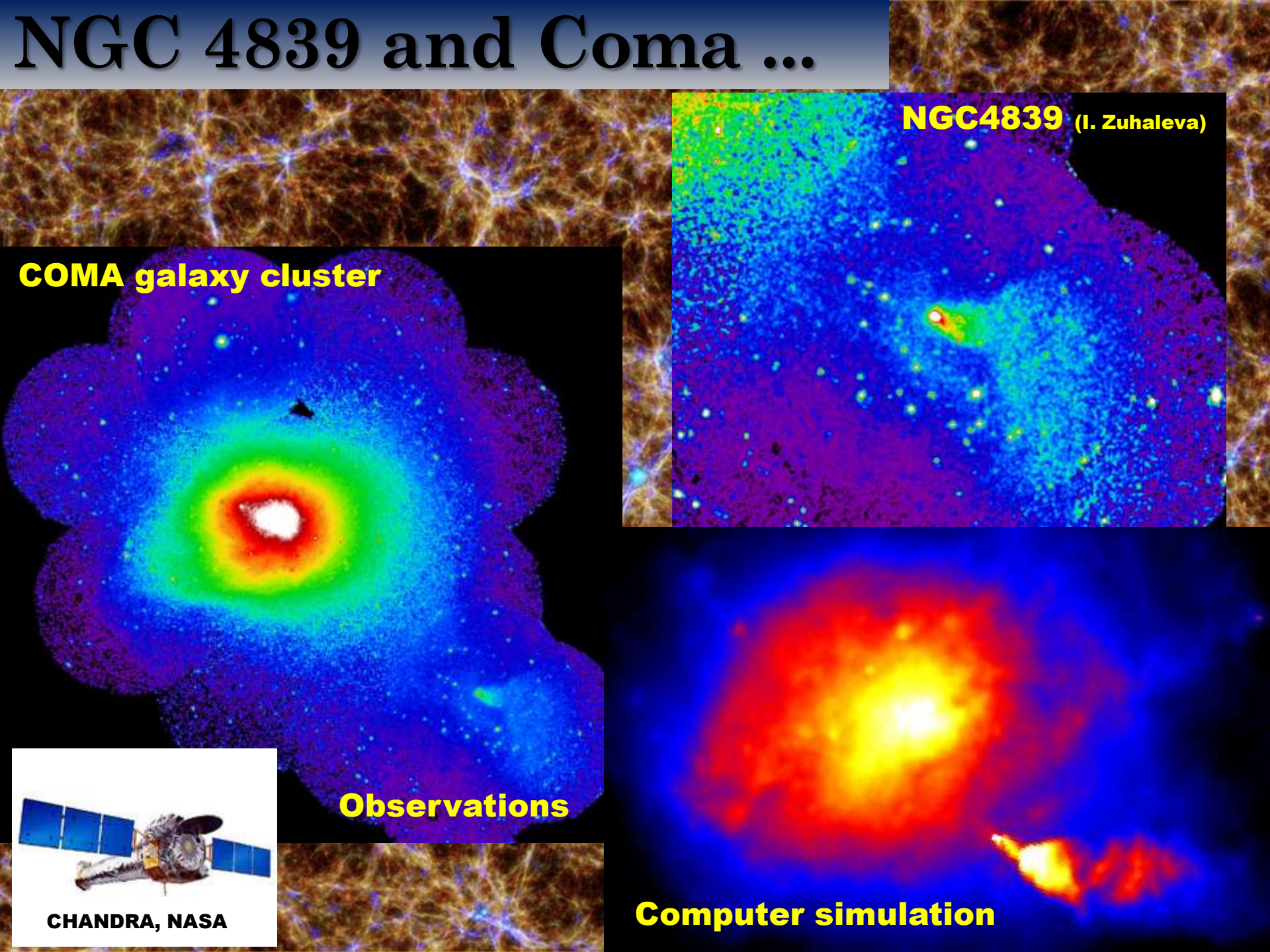
Normalisation
to point of in-fall



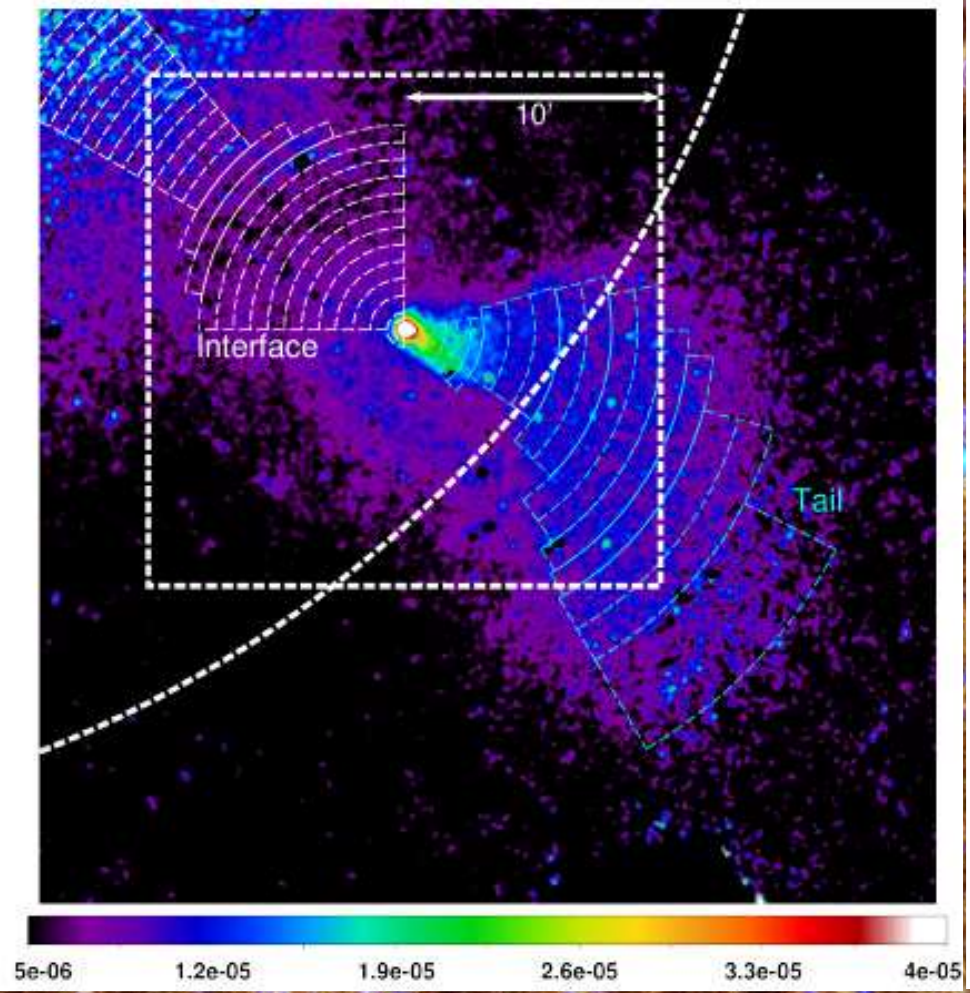
Low mass: orbital paramters
High mass: larger mass

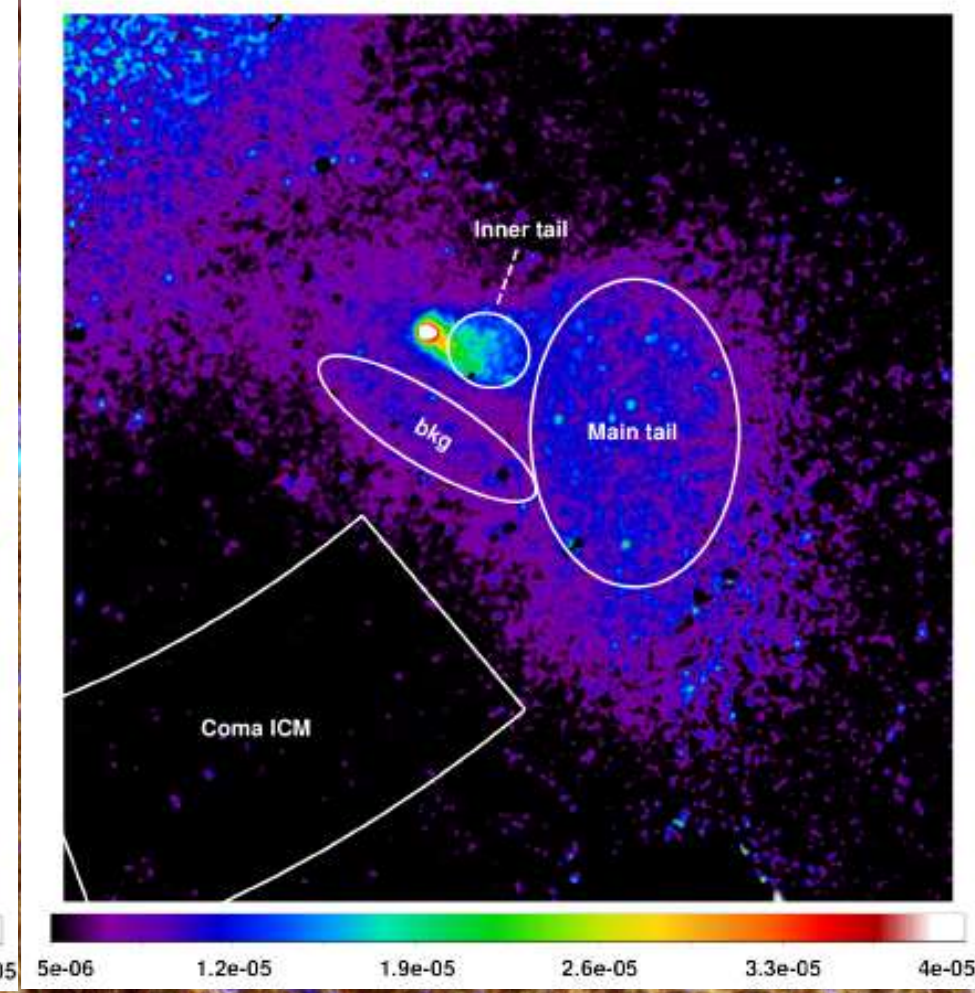
Lotz+ 2018

NGC 4839 and Coma ...



NGC 4839 and Coma ...

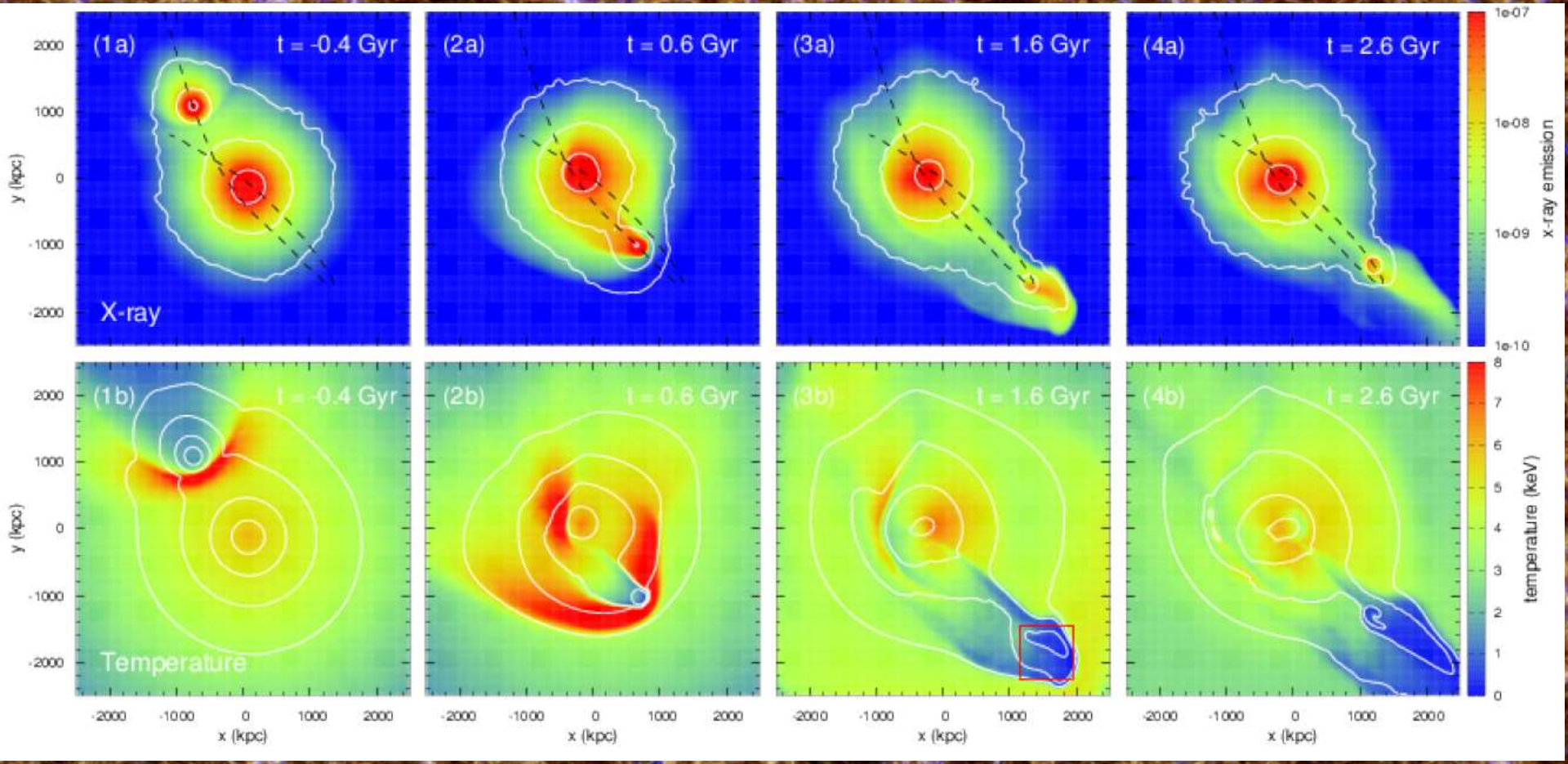




Lyskova, Churazov, + 2019

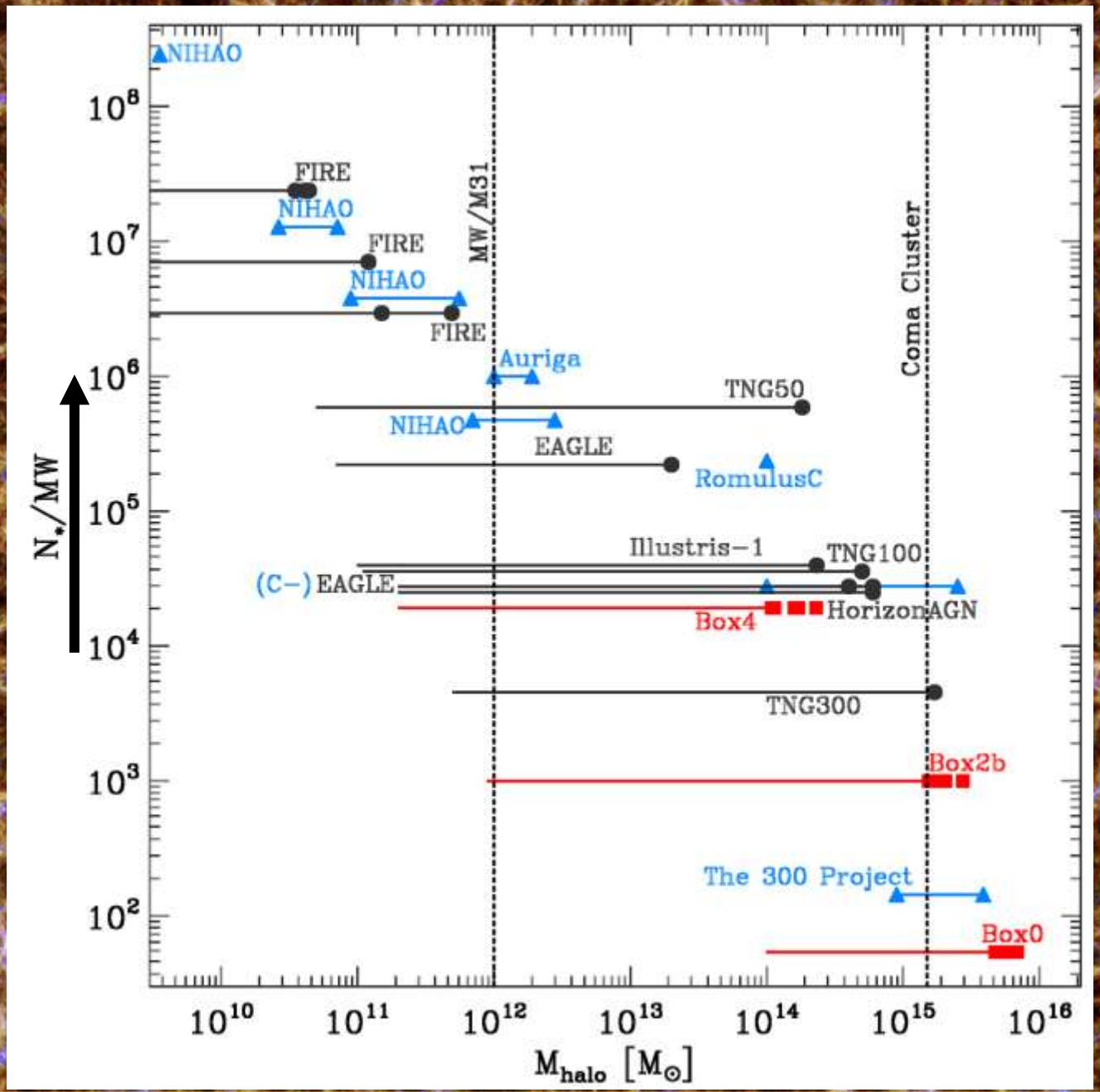
NGC 4839 and Coma ...

Idealized merger simualtion by E. Roediger

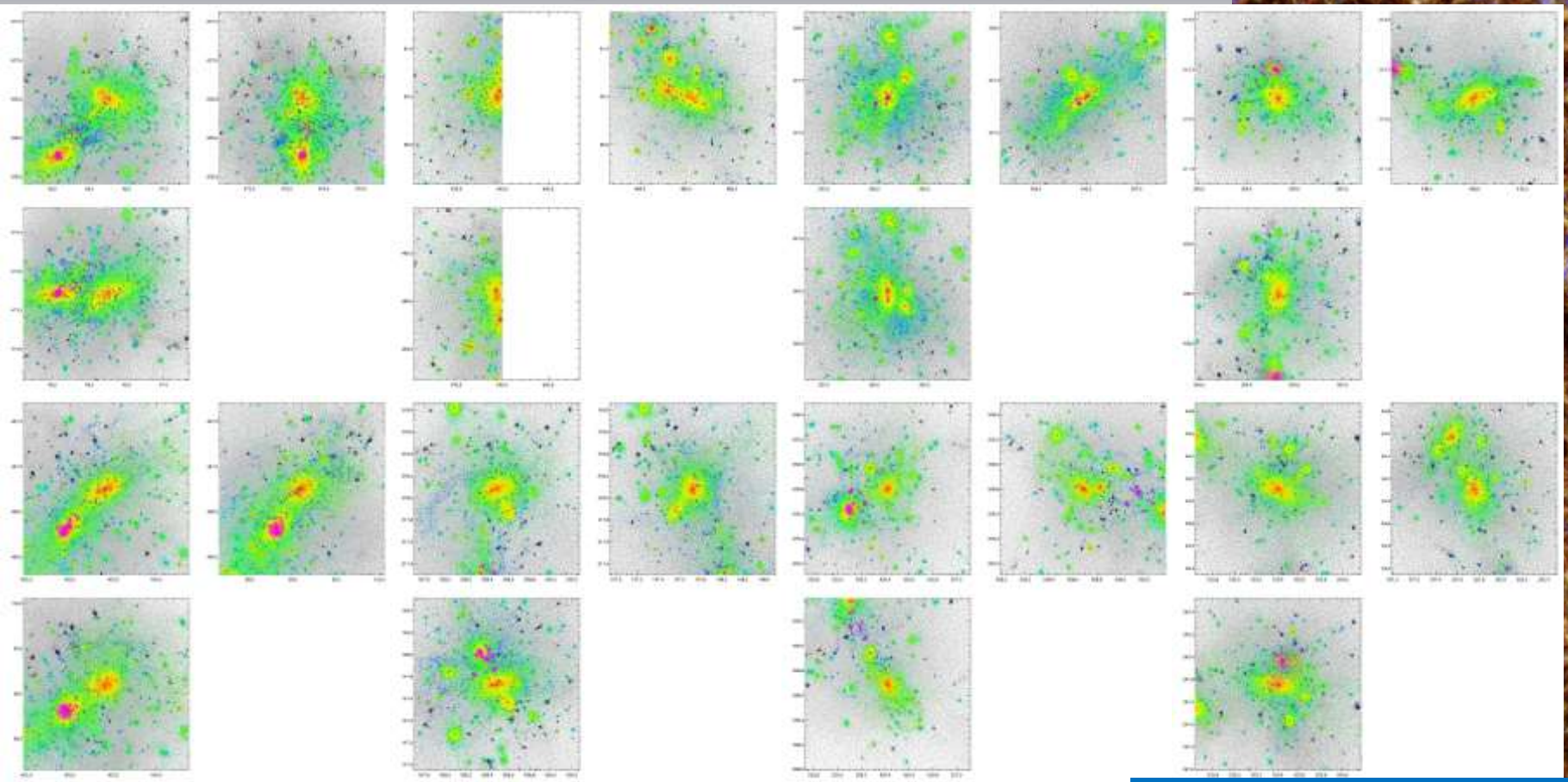


Lyskova, Churazov, + 2019

Test with cosmological simulations?

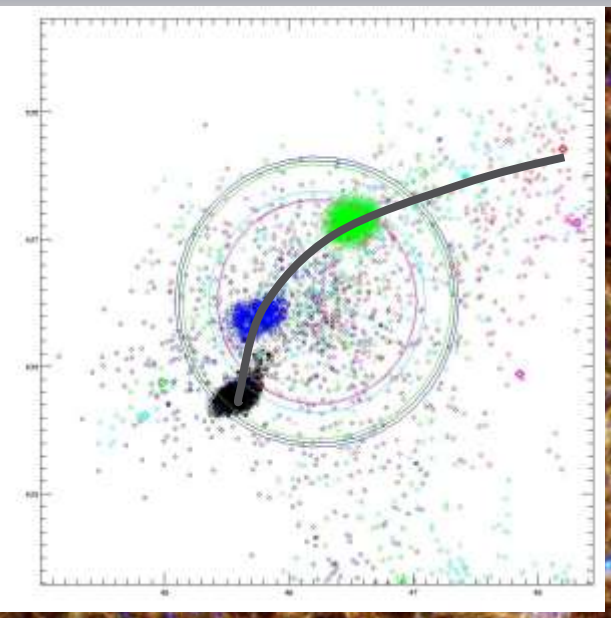


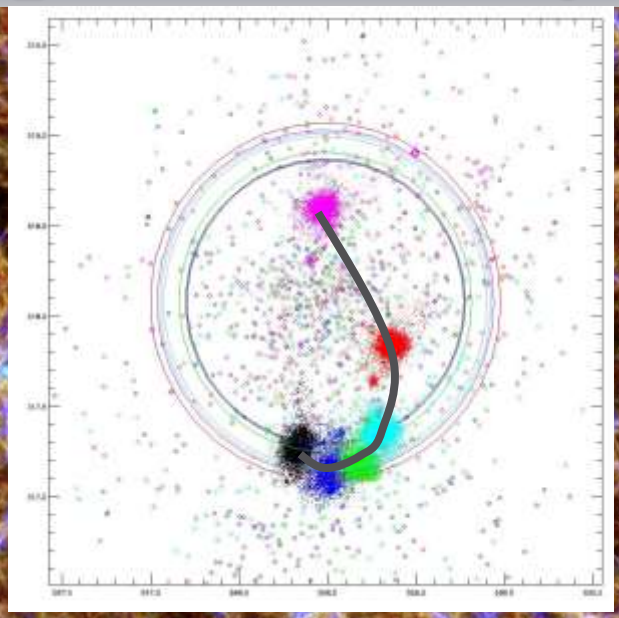
What is the probability ?

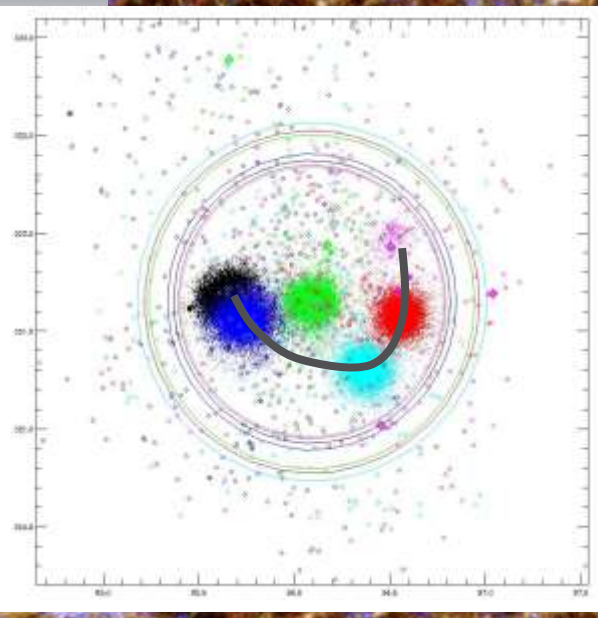


- Box: (1Gpc)^3
- 402 Clusters ($M>4e14M_{sol}$)
- 11 candidates ($M_{gas}>4e11$)

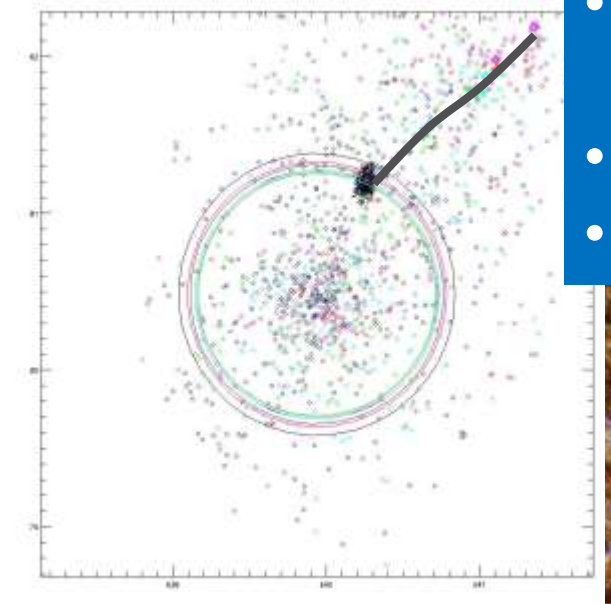
What is the probability ?

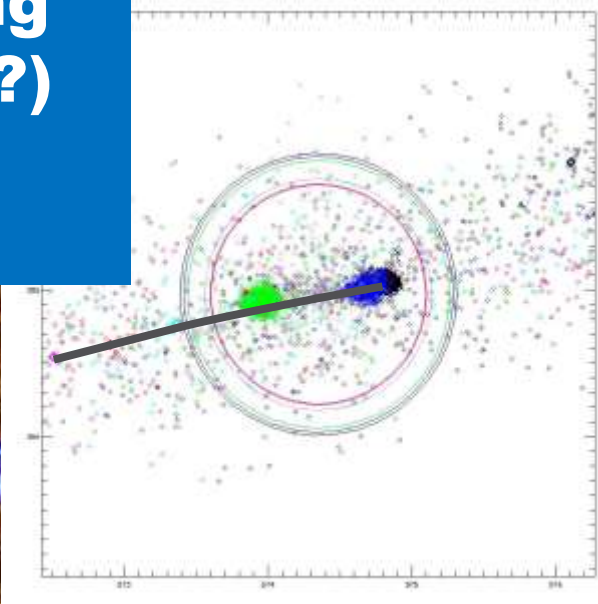




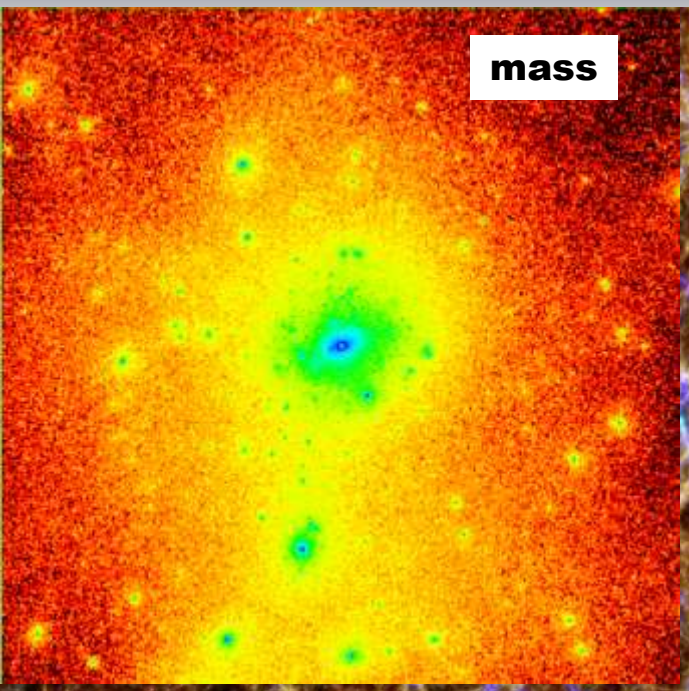


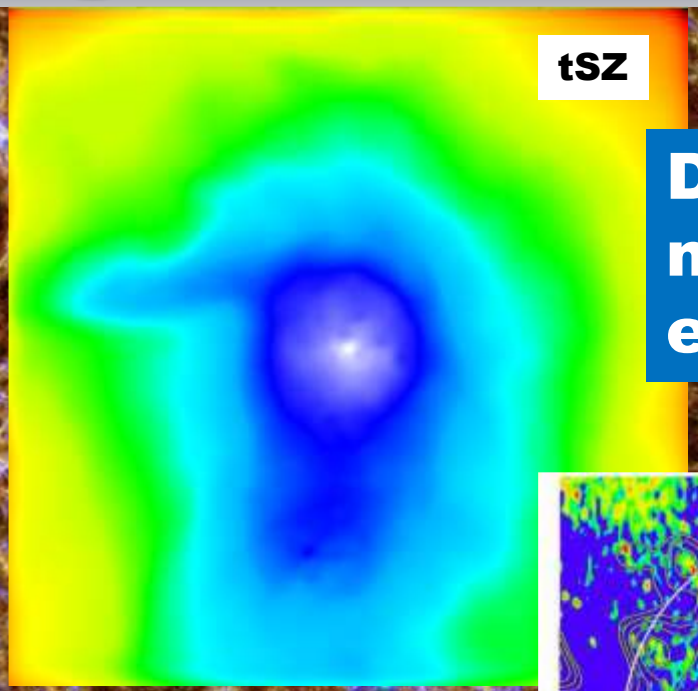
- 4 after first crossing with 1 at the turn (?)
- 6 at first infall
- 1 unclear



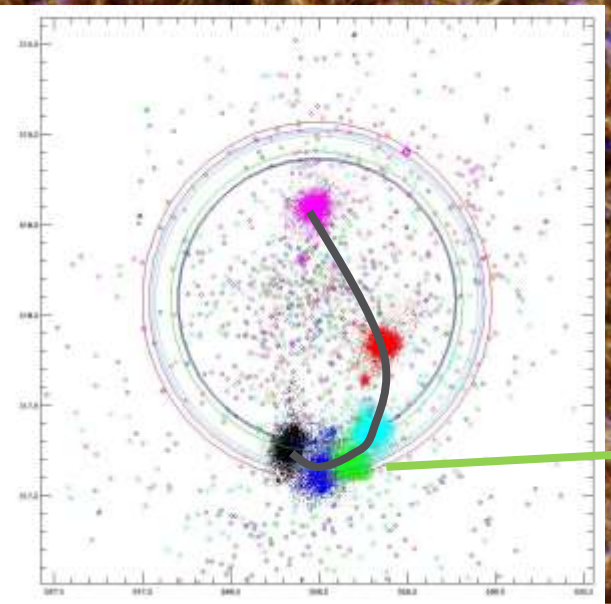


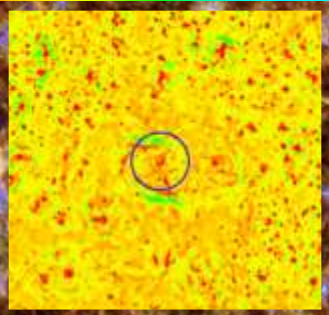
Do we have a good case ?

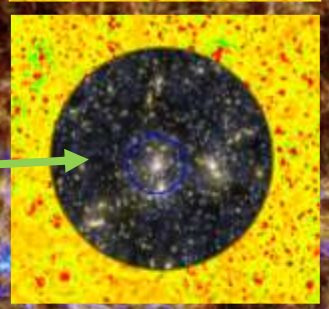




Do the shocks match our expevtation?







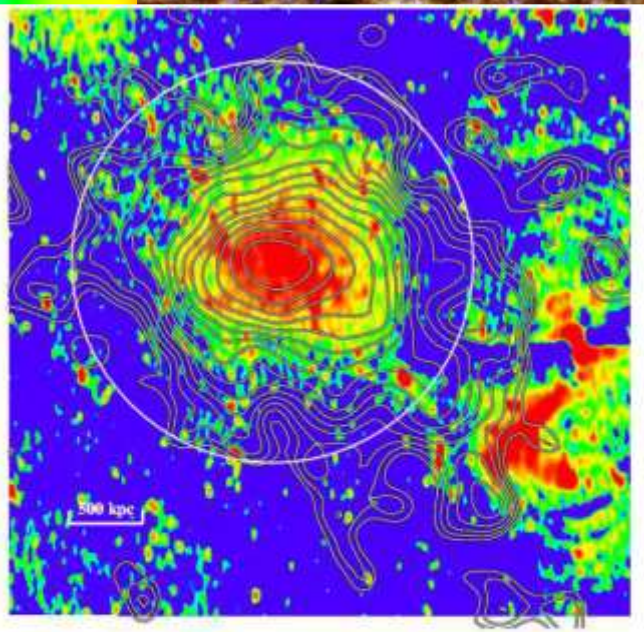
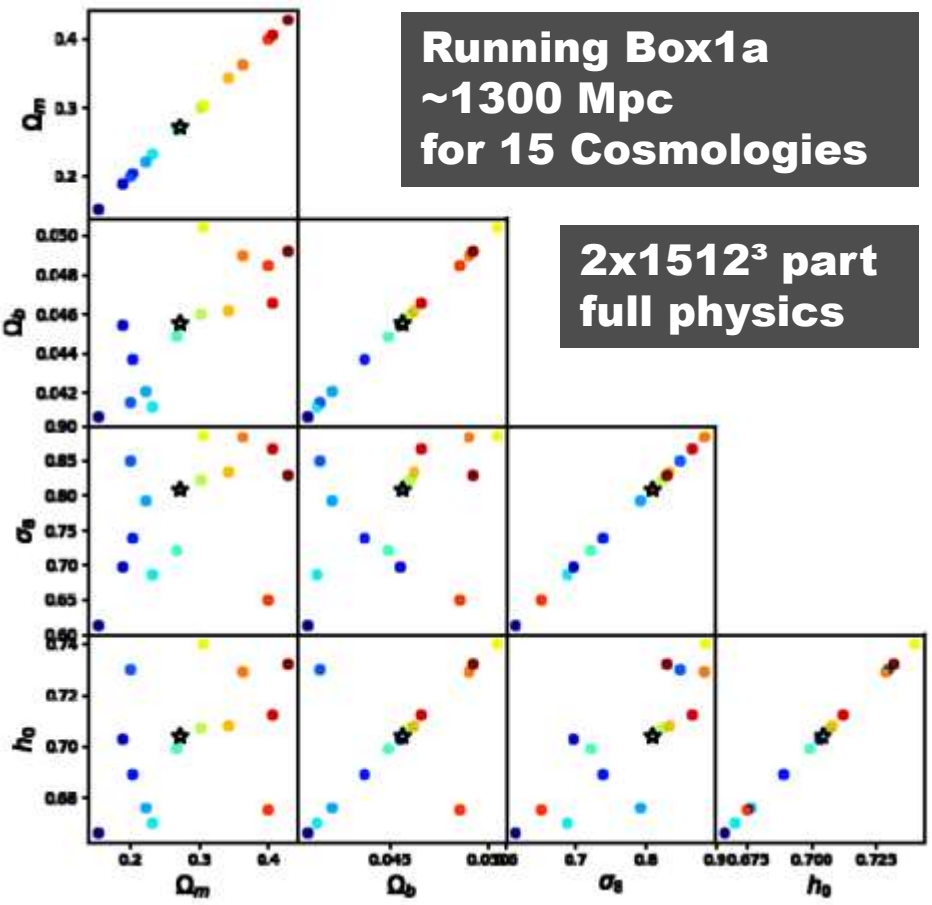


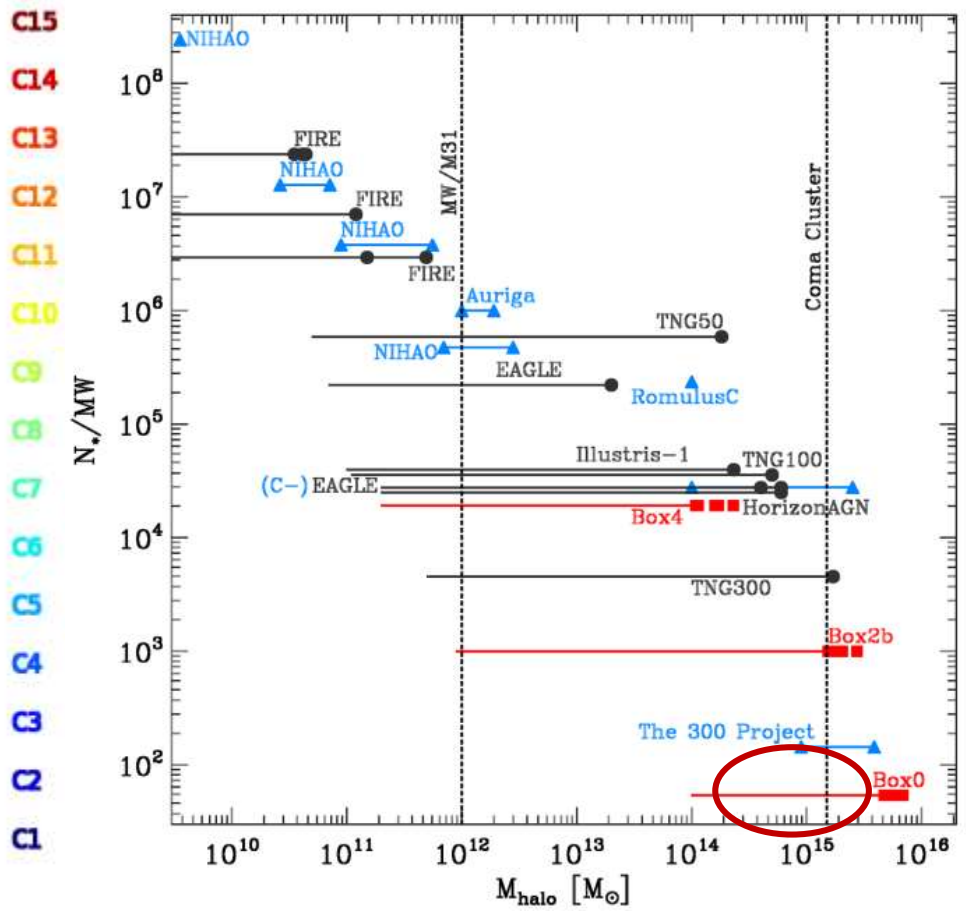
Fig. 8: Westerbork Synthesis Radio Telescope 352 MHz total intensity image of the Coma Cluster from figure 3 of Brown & Rudnick (2011) overlaid with the y contour levels from Fig. 2. Most of the radio flux from compact sources has been subtracted; the resolution is 133arcsec × 68arcsec at −1.5 degrees (W of N). The white circle indicates R_{500}.

Let's just do it !



Running Box1a
~1300 Mpc
for 15 Cosmologies

2x1512³ part
full physics

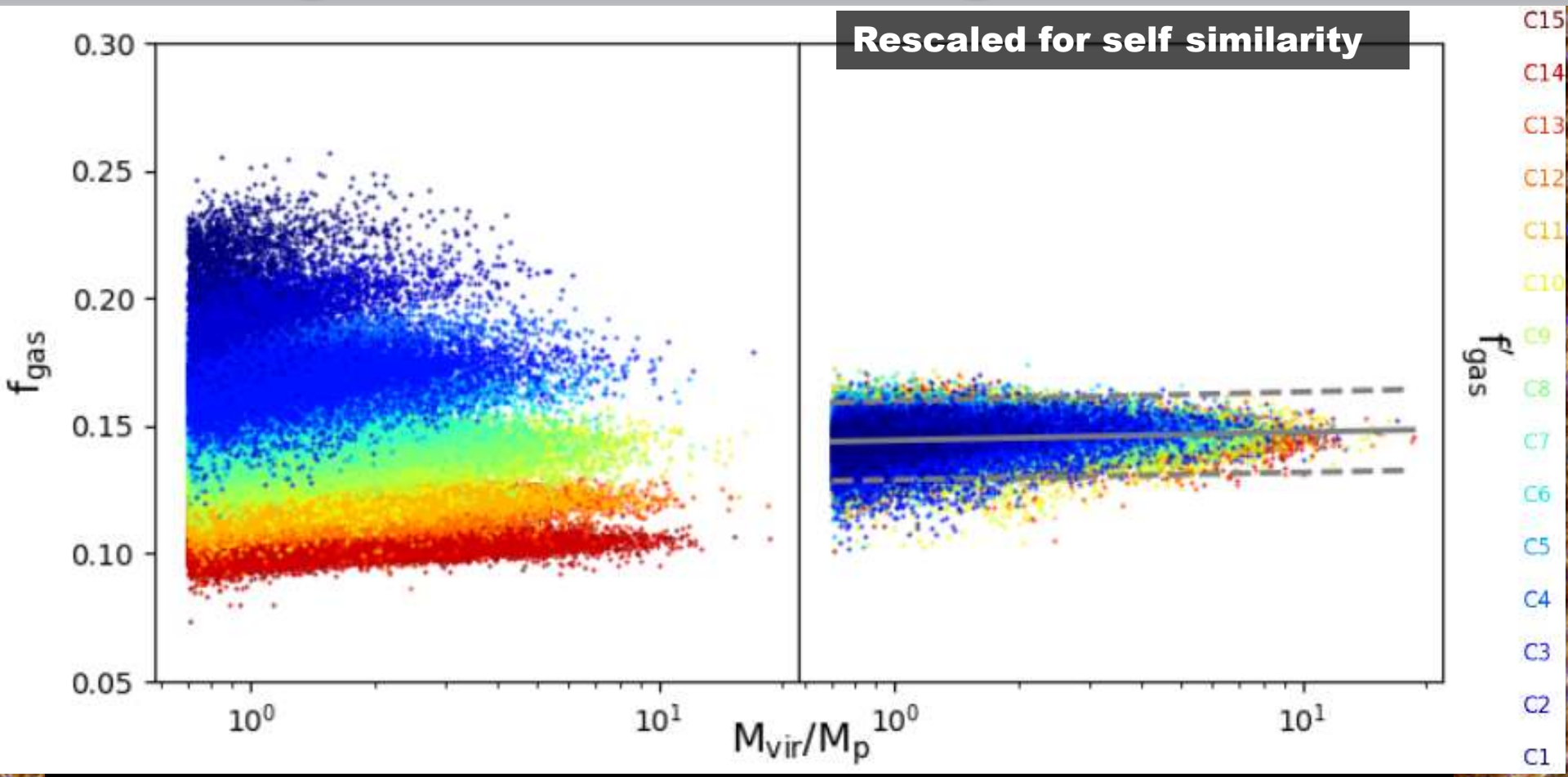


$$Y = A\left(\frac{M}{M_p}\right)^{\alpha} F(z)^{\beta} \left(\frac{\Omega_b/\Omega_b^p}{\Omega_m/\Omega_m^p}\right)^{\gamma_\Omega} \left(\frac{h_0}{h_0^p}\right)^{\gamma_{h_0}} \left(\frac{\sigma_8}{\sigma_8^p}\right)^{\gamma_{\sigma_8}} + \sigma$$

$Y \equiv$ Observable

Singh, Saro, + (in prep)

Scaling realtion for f_gas

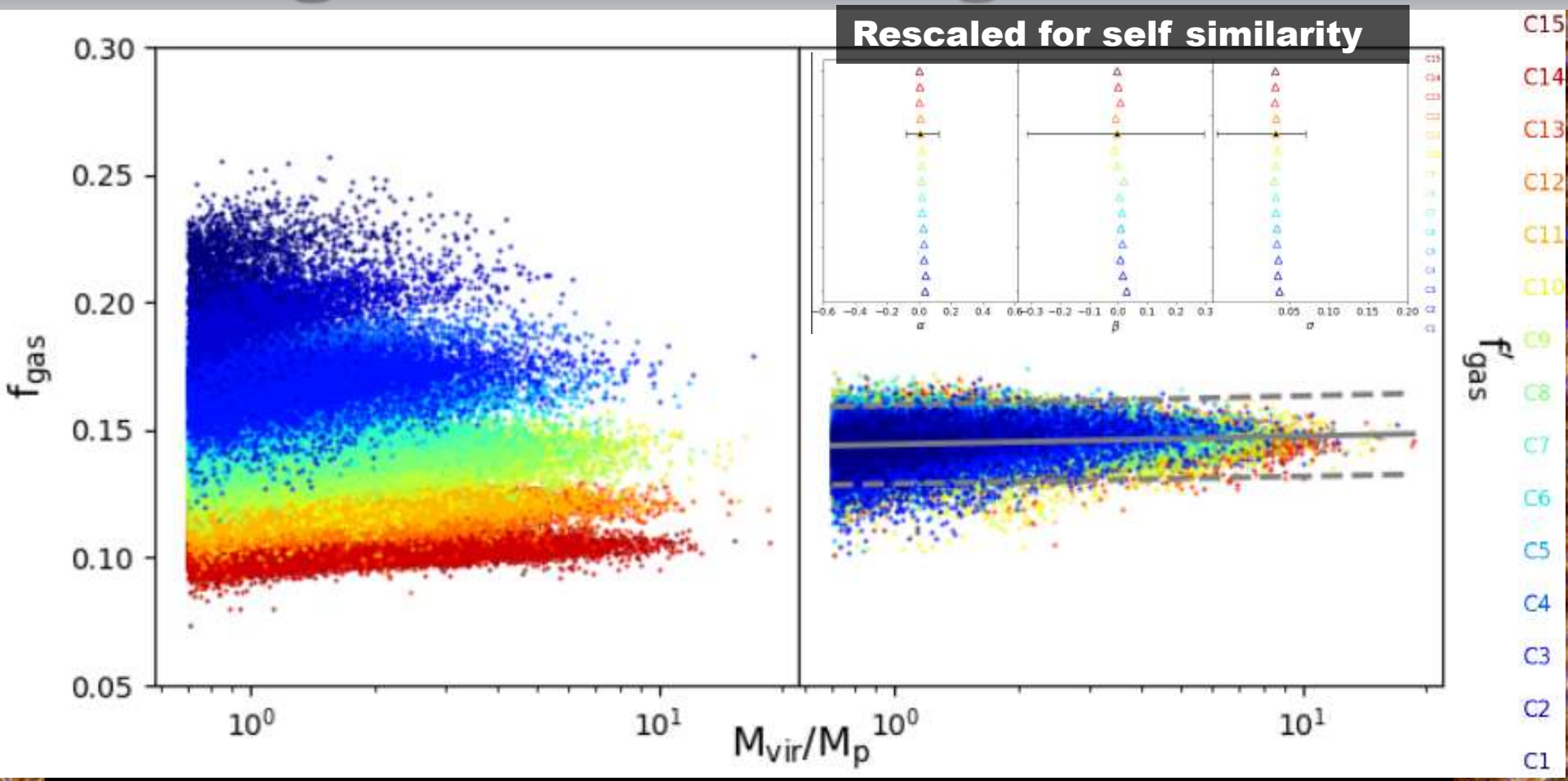


$$Y = A\left(\frac{M}{M_p}\right)^{\alpha} F(z)^{\beta} \left(\frac{\Omega_b/\Omega_b^p}{\Omega_m/\Omega_m^p}\right)^{\gamma_\Omega} \left(\frac{h_0}{h_0^p}\right)^{\gamma_{h0}} \left(\frac{\sigma_8}{\sigma_8^p}\right)^{\gamma_{\sigma 8}} + \sigma$$

$Y \equiv$ Observable

Singh, Saro, + (in prep)

Scaling realtion for f_gas

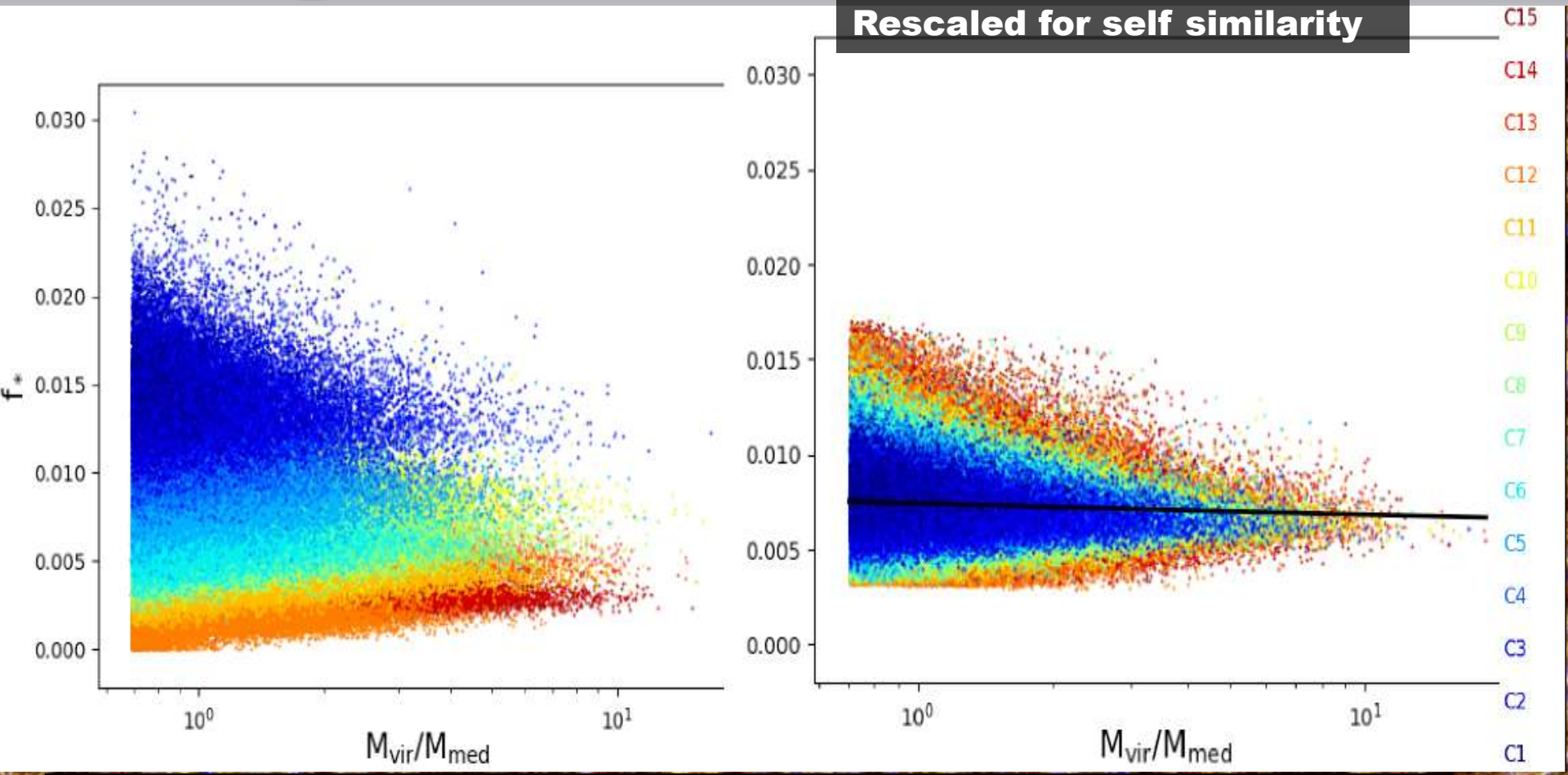


$$Y = A\left(\frac{M}{M_p}\right)^{\alpha} F(z)^{\beta} \left(\frac{\Omega_b/\Omega_b^p}{\Omega_m/\Omega_m^p}\right)^{\gamma_\Omega} \left(\frac{h_0}{h_0^p}\right)^{\gamma_{h_0}} \left(\frac{\sigma_8}{\sigma_8^p}\right)^{\gamma_{\sigma_8}} + \sigma$$

$Y \equiv$ Observable

Singh, Saro, + (in prep)

Scaling realtion for f_stars

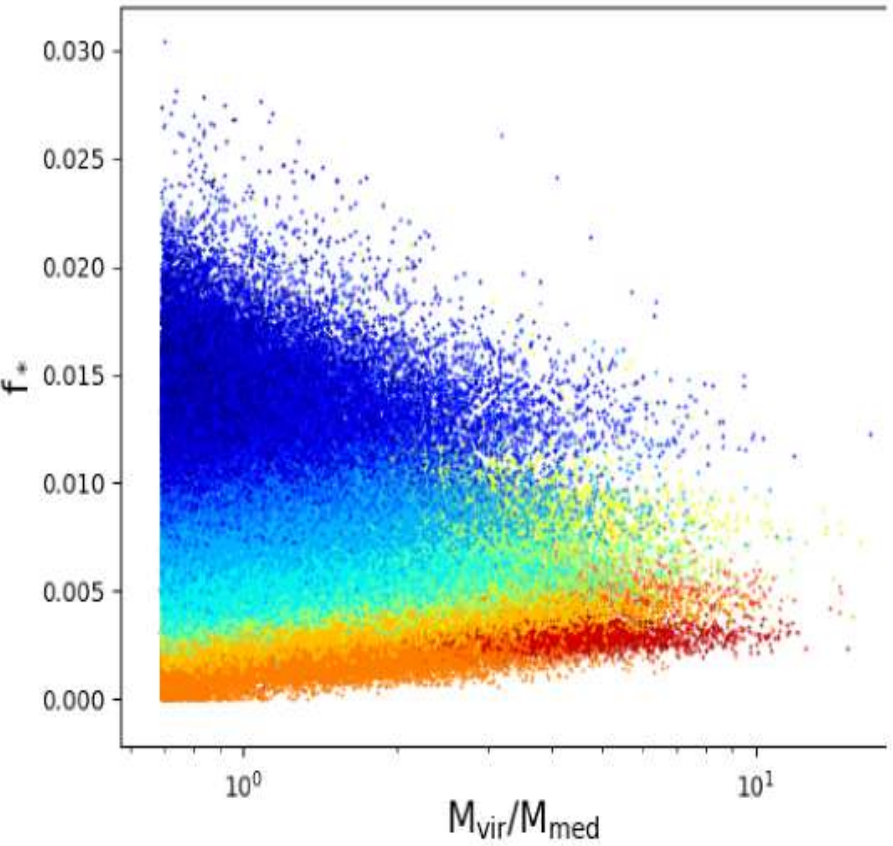


$$Y = A\left(\frac{M}{M_p}\right)^{\alpha} F(z)^{\beta} \left(\frac{\Omega_b/\Omega_b^p}{\Omega_m/\Omega_m^p}\right)^{\gamma_\Omega} \left(\frac{h_0}{h_0^p}\right)^{\gamma_{h0}} \left(\frac{\sigma_8}{\sigma_8^p}\right)^{\gamma_{\sigma 8}} + \sigma$$

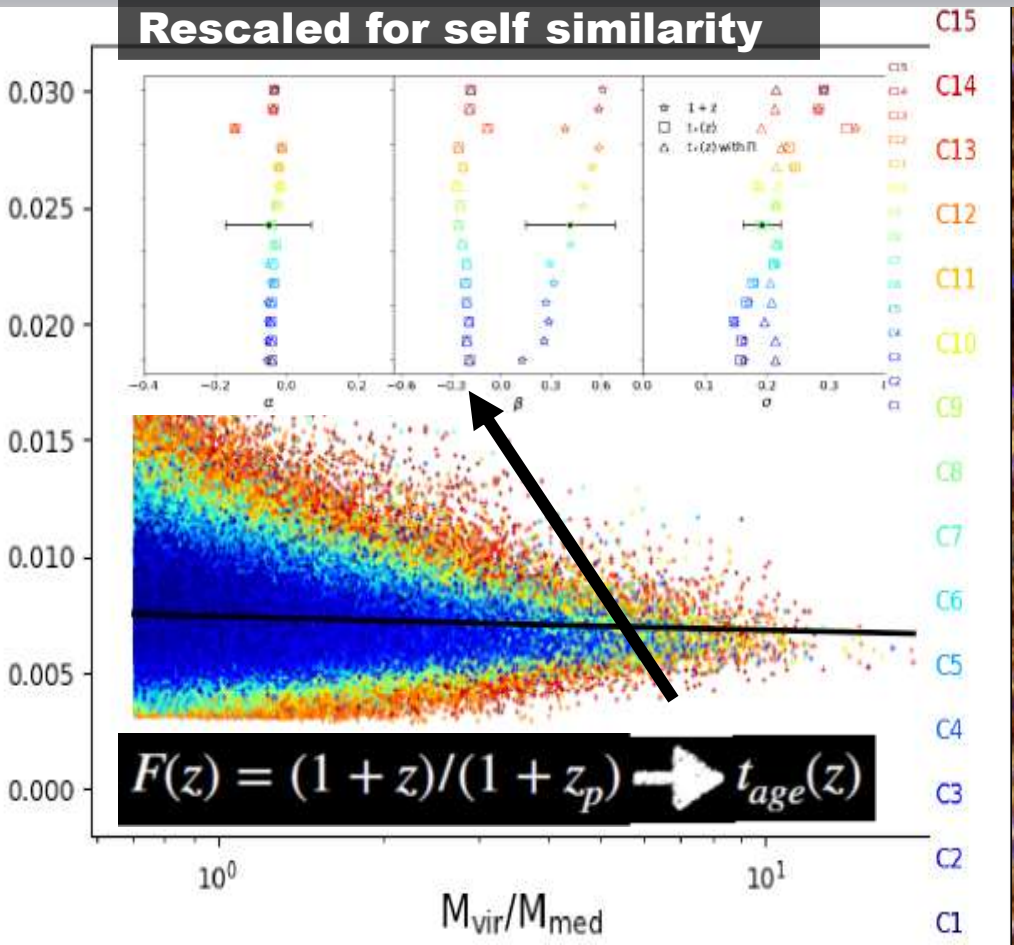
$Y \equiv$ Observable

Singh, Saro, + (in prep)

Scaling realtion for f_stars



Rescaled for self similarity

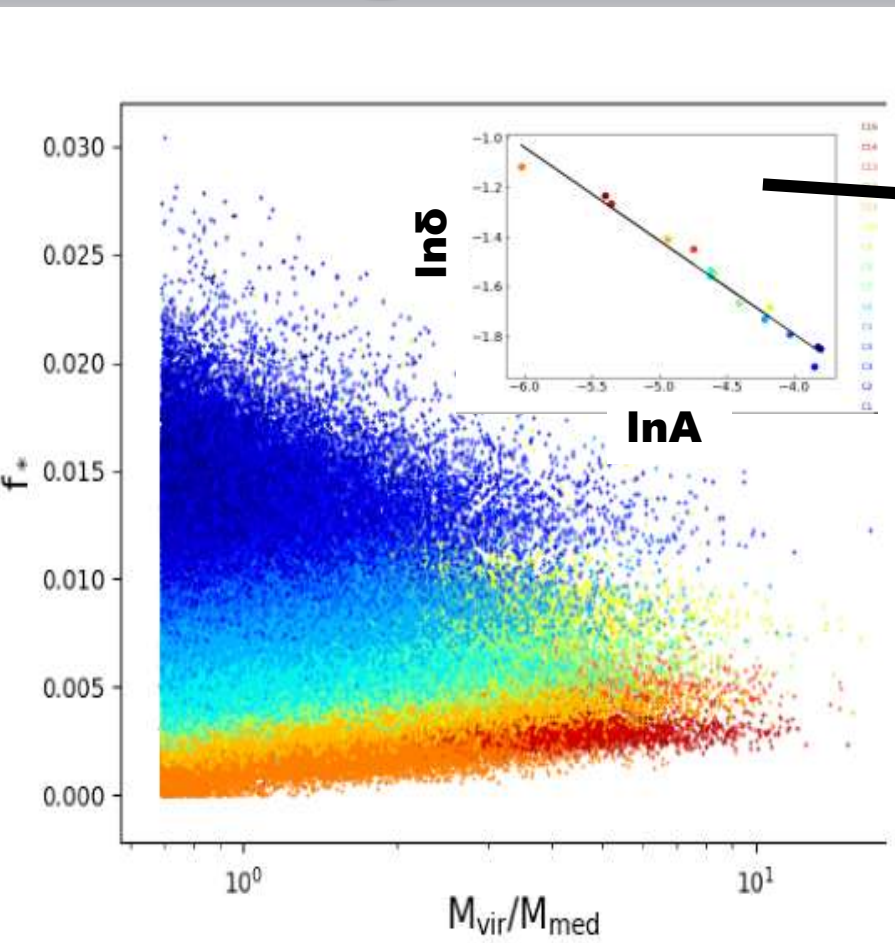


$$Y = A\left(\frac{M}{M_p}\right)^{\alpha} F(z)^{\beta} \left(\frac{\Omega_b/\Omega_b^p}{\Omega_m/\Omega_m^p}\right)^{\gamma_\Omega} \left(\frac{h_0}{h_0^p}\right)^{\gamma_{h0}} \left(\frac{\sigma_8}{\sigma_8^p}\right)^{\gamma_{\sigma 8}} + \sigma$$

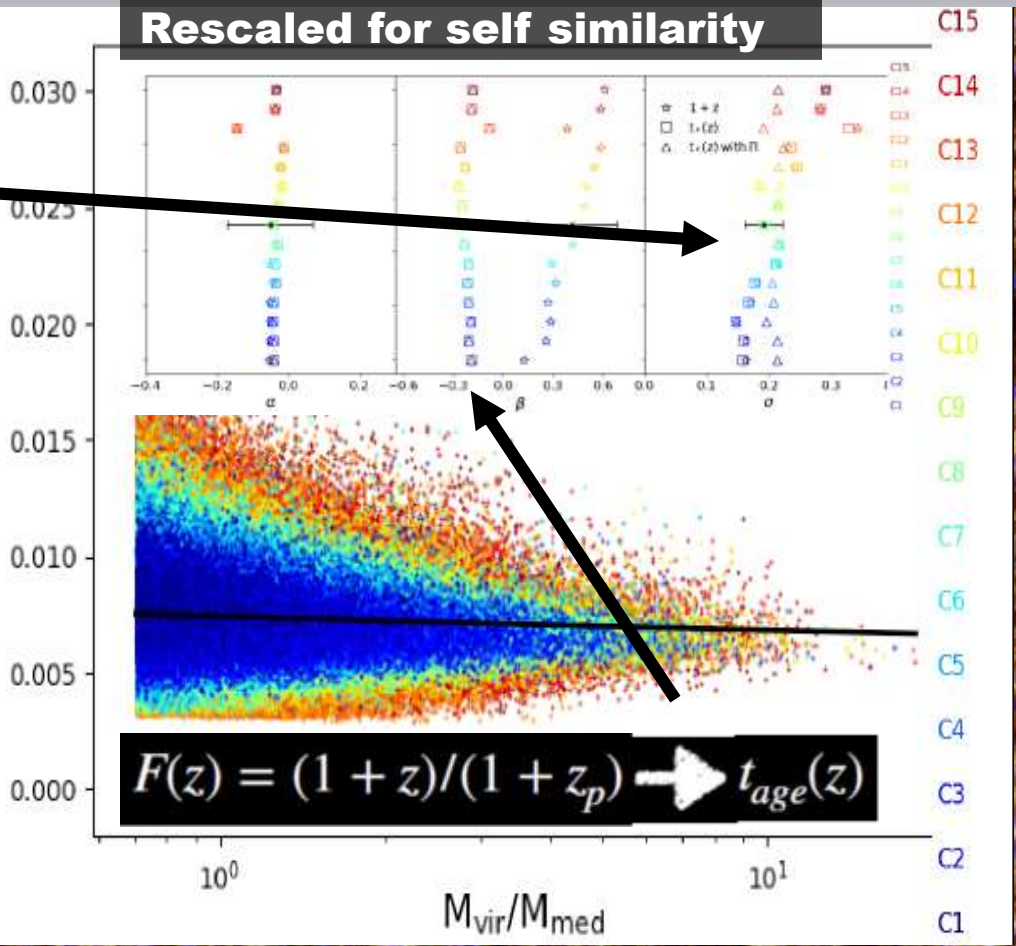
$Y \equiv$ Observable

Singh, Saro, + (in prep)

Scaling realtion for f_stars



Rescaled for self similarity

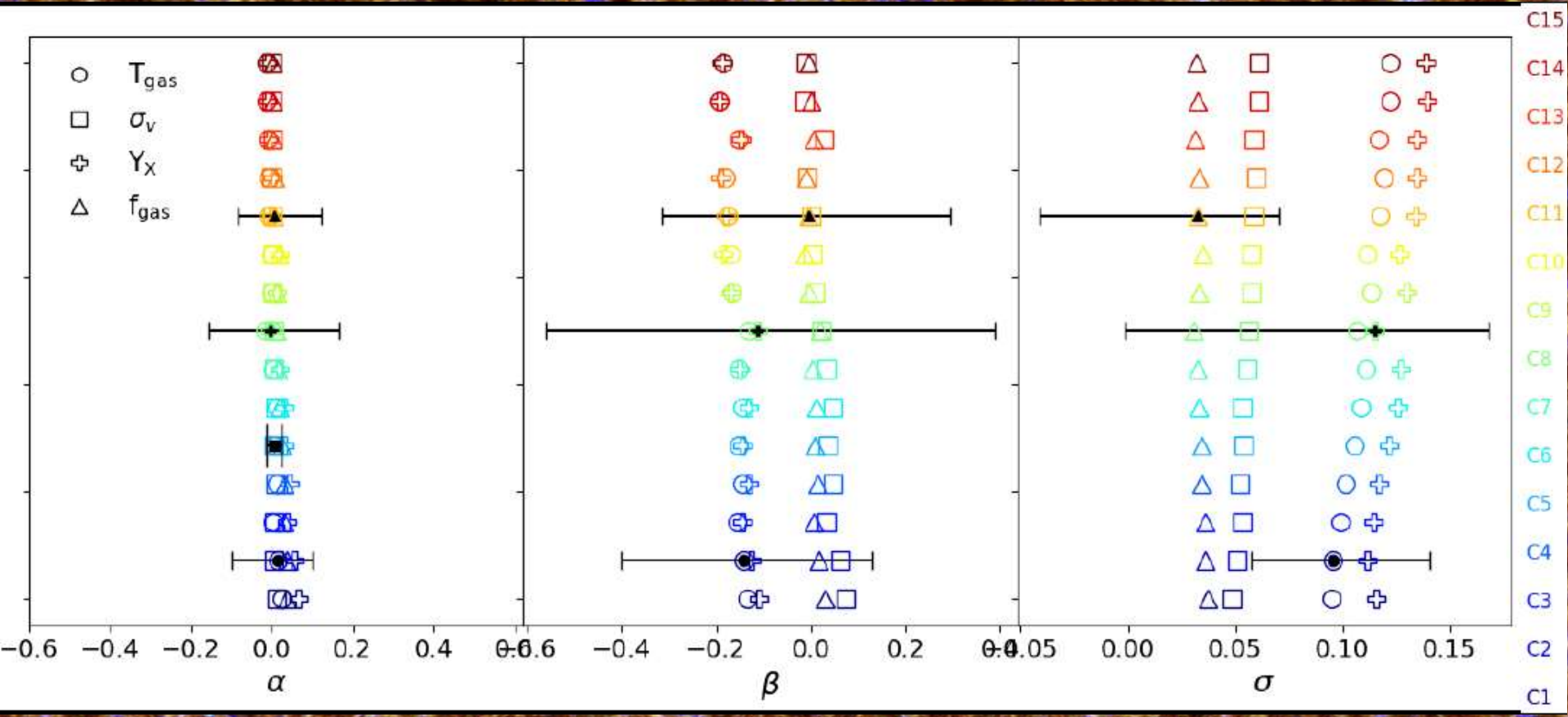


$$Y = A\left(\frac{M}{M_p}\right)^{\alpha} F(z)^{\beta} \left(\frac{\Omega_b/\Omega_b^p}{\Omega_m/\Omega_m^p}\right)^{\gamma_\Omega} \left(\frac{h_0}{h_0^p}\right)^{\gamma_{h0}} \left(\frac{\sigma_8}{\sigma_8^p}\right)^{\gamma_{\sigma 8}} + \sigma$$

$Y \equiv$ Observable

Singh, Saro, + (in prep)

Scaling realtion sumary



$$Y = A\left(\frac{M}{M_p}\right)^{\alpha} F(z)^{\beta} \left(\frac{\Omega_b/\Omega_b^p}{\Omega_m/\Omega_m^p}\right)^{\gamma_\Omega} \left(\frac{h_0}{h_0^p}\right)^{\gamma_{h_0}} \left(\frac{\sigma_8}{\sigma_8^p}\right)^{\gamma_{\sigma 8}} + \sigma$$

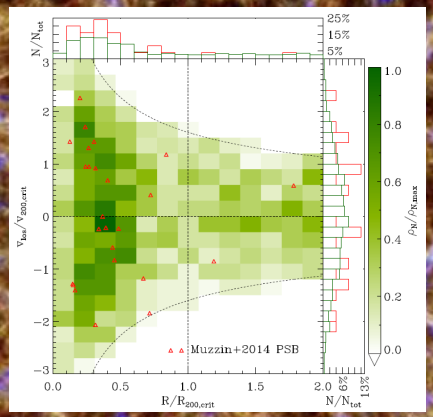
$Y \equiv$ Observable

Singh, Saro, + (in prep)

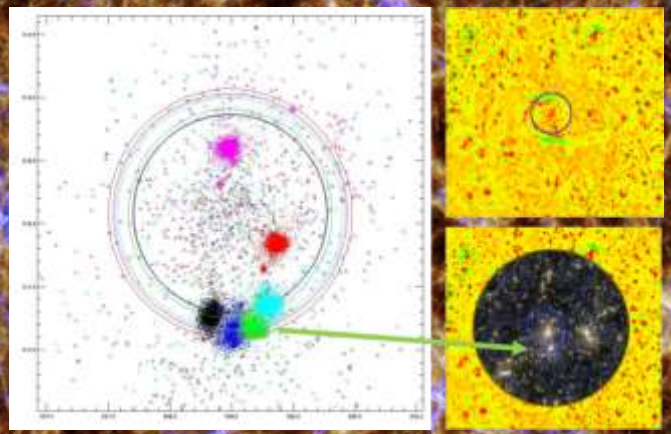
Final Conclusions

Galaxies:

Inafall perspective:
Mostly gone after one orbit...

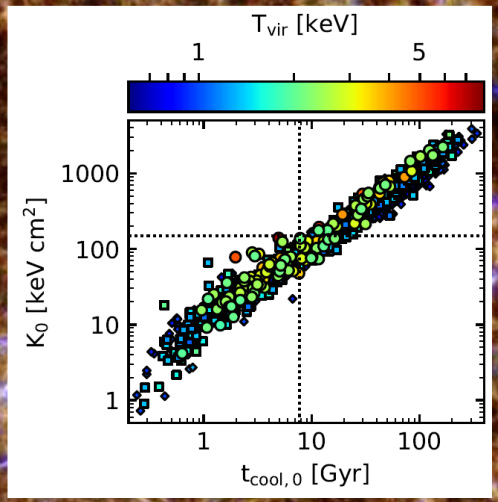


... unless you do a wront turn !



Clusters:

are CC or not CC ...



... and self similar even in other Universes!