Exploiting the Planck legacy: properties of SZ-selected clusters at high-z and high mass

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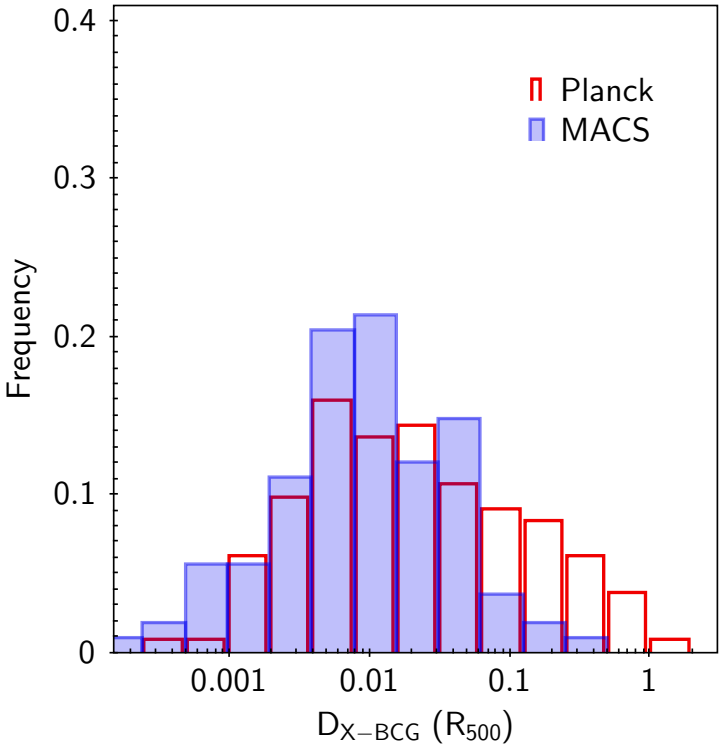
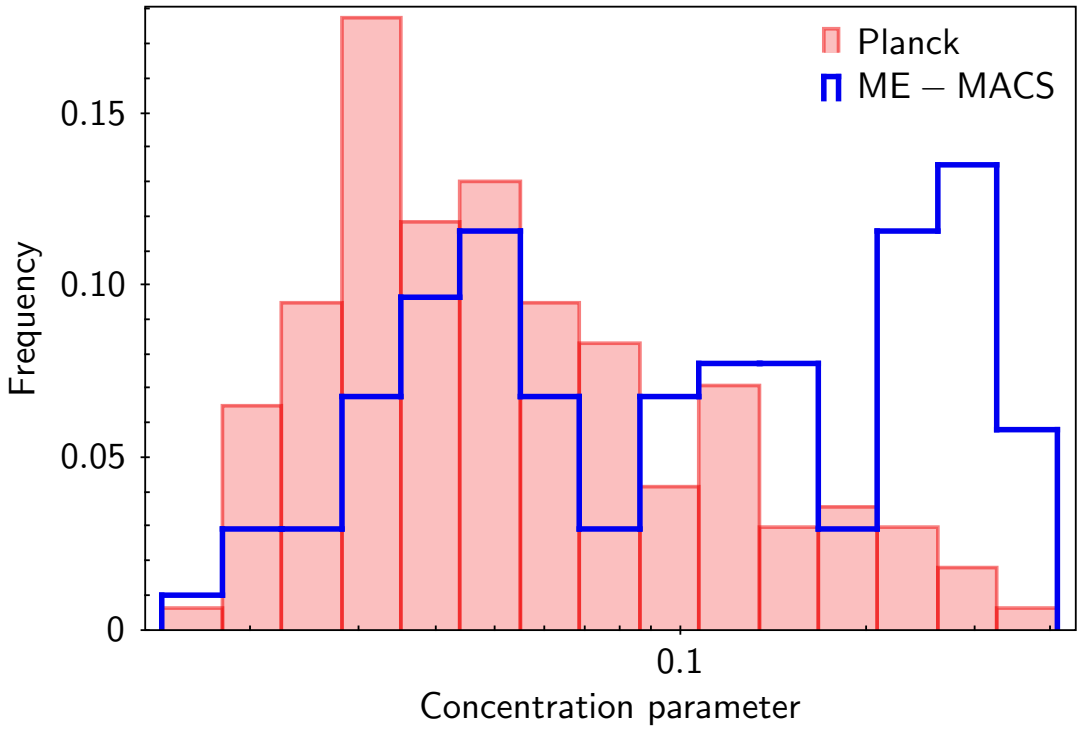
Dynamical state of Planck Clusters

MR et al (2016)

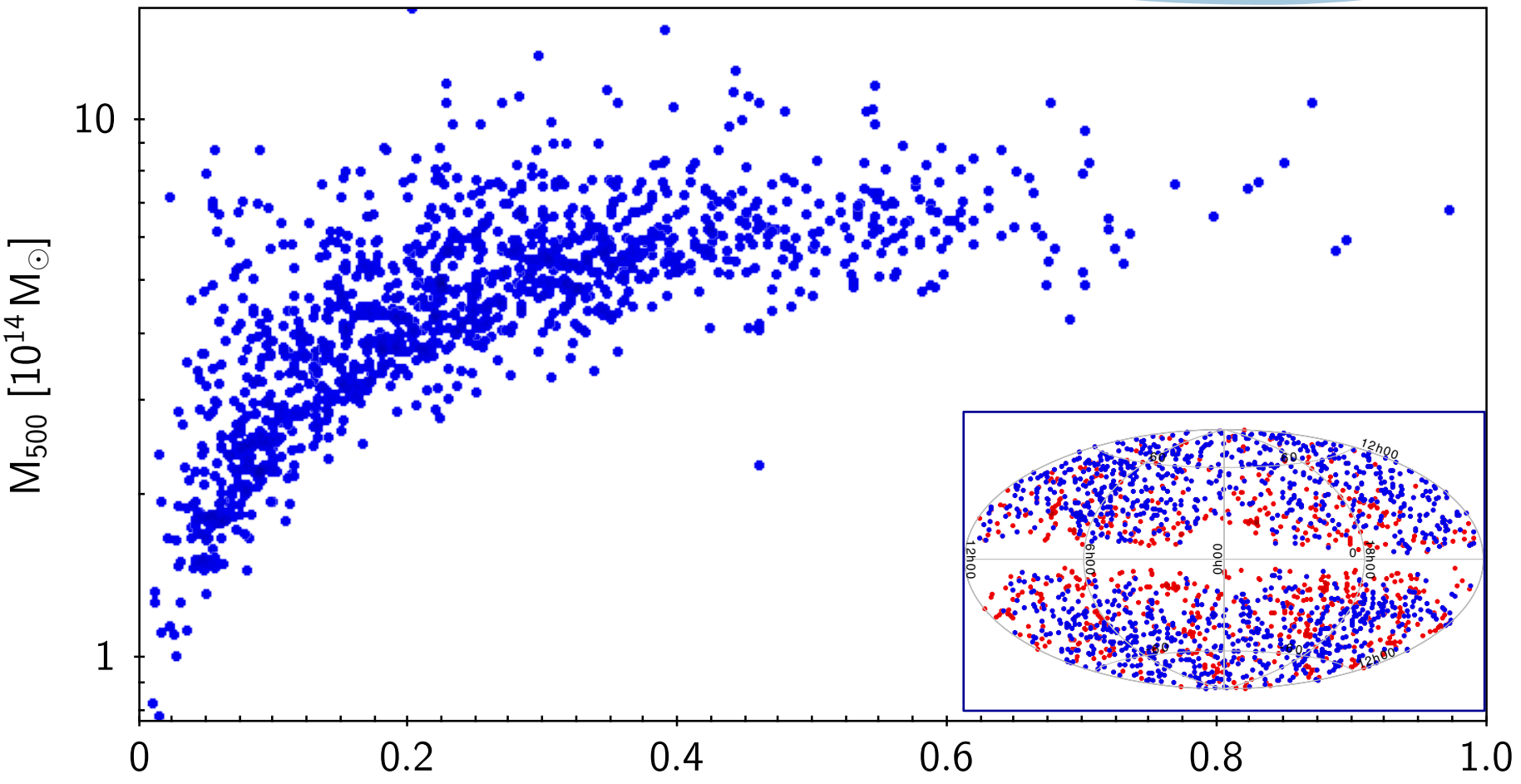


MR et al (2017)



Significant differences in dynamical state of Planck-selected clusters with respect to X-ray based samples (see also Andrade-Santos et al 2017, Lovisari et al 2017):
Selection effects in X-ray flux-limited surveys

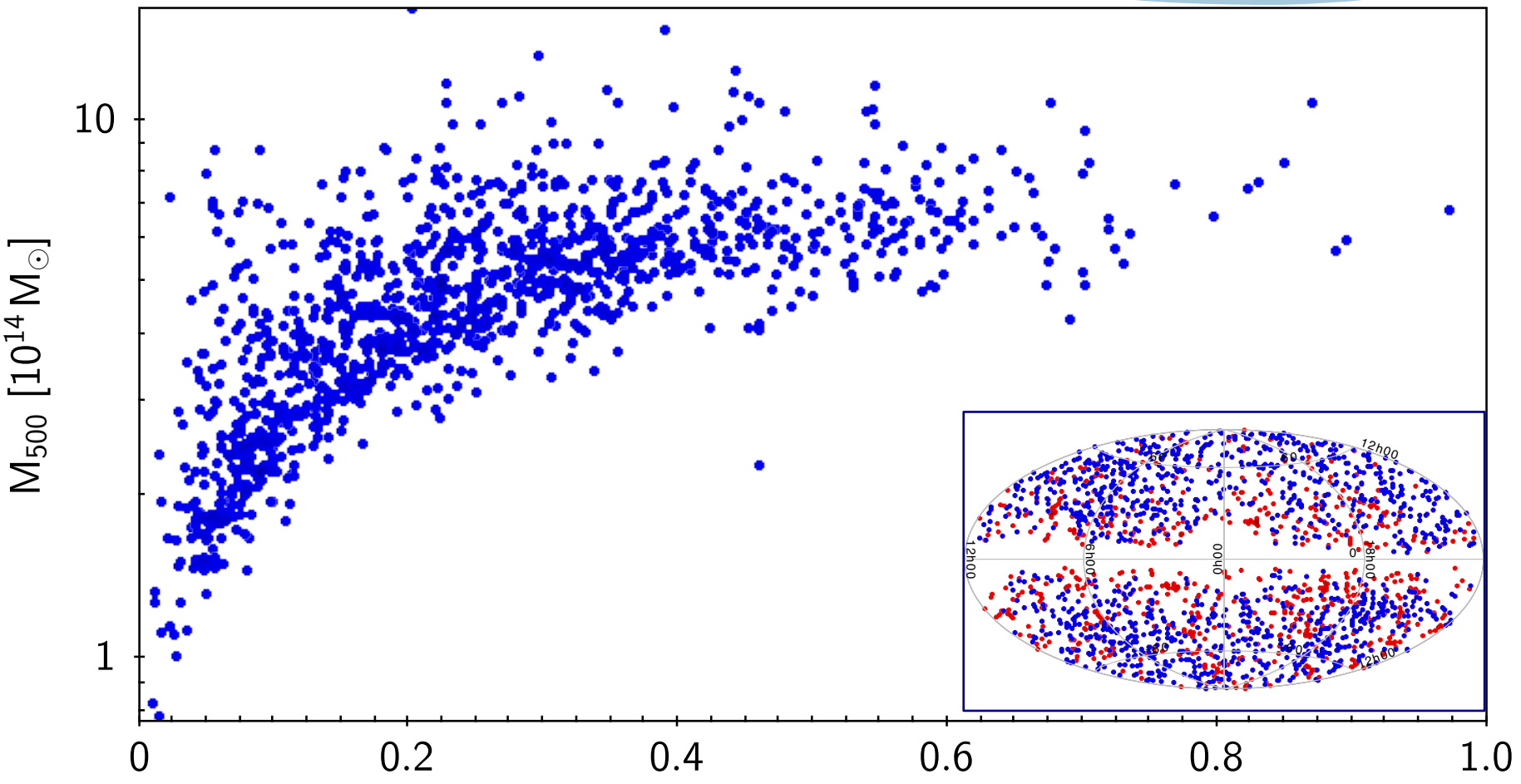
The Planck (SZ) legacy



1963 Sunyaev-Zeldovich sources in 3 catalogues

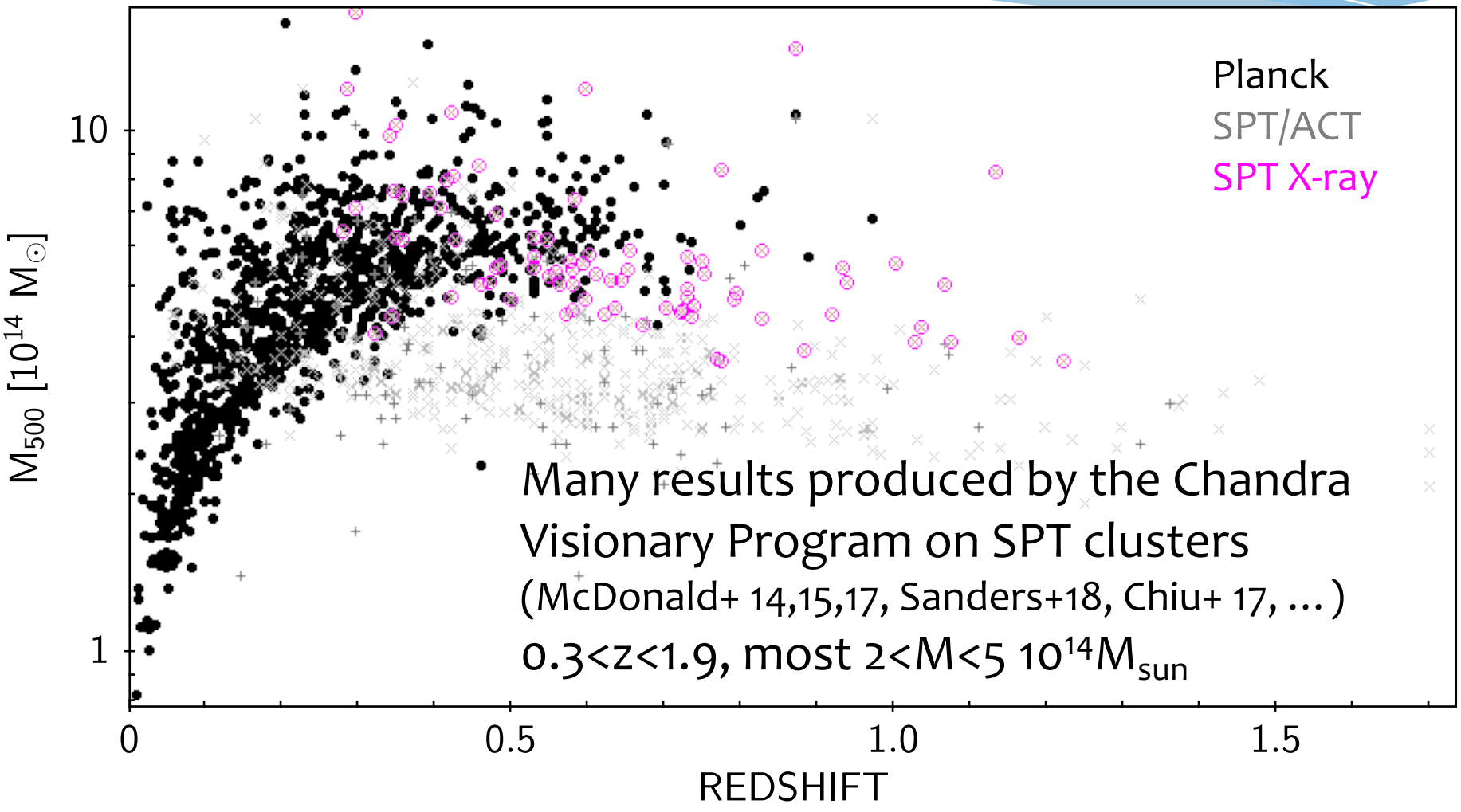
>1200 confirmed clusters (z measured)

The Planck (SZ) legacy

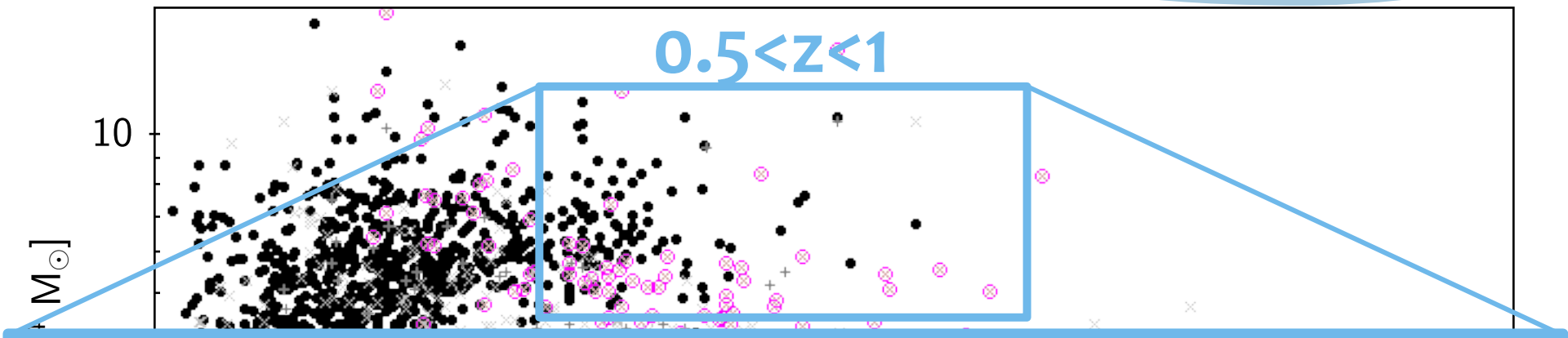


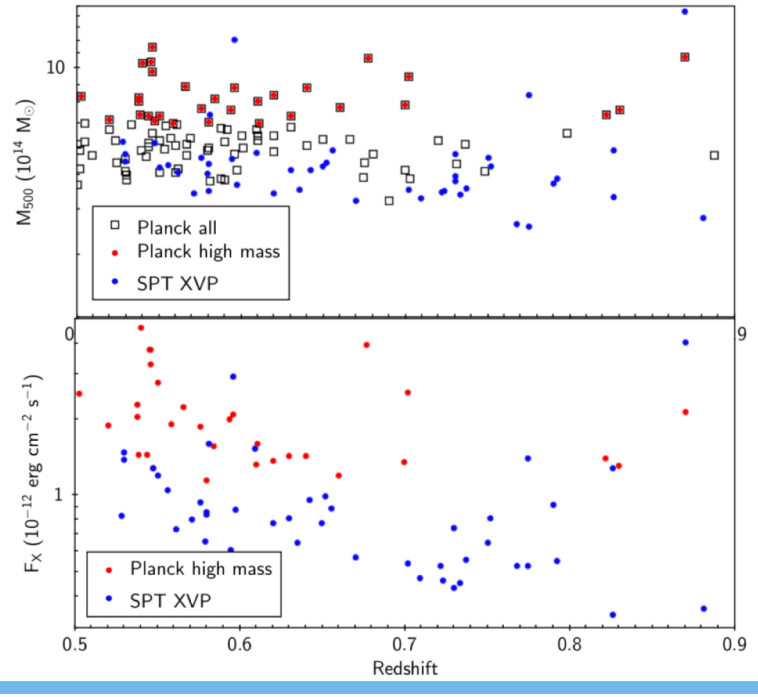
Several subsamples starting to be investigated with follow-up multi-wavelength observations

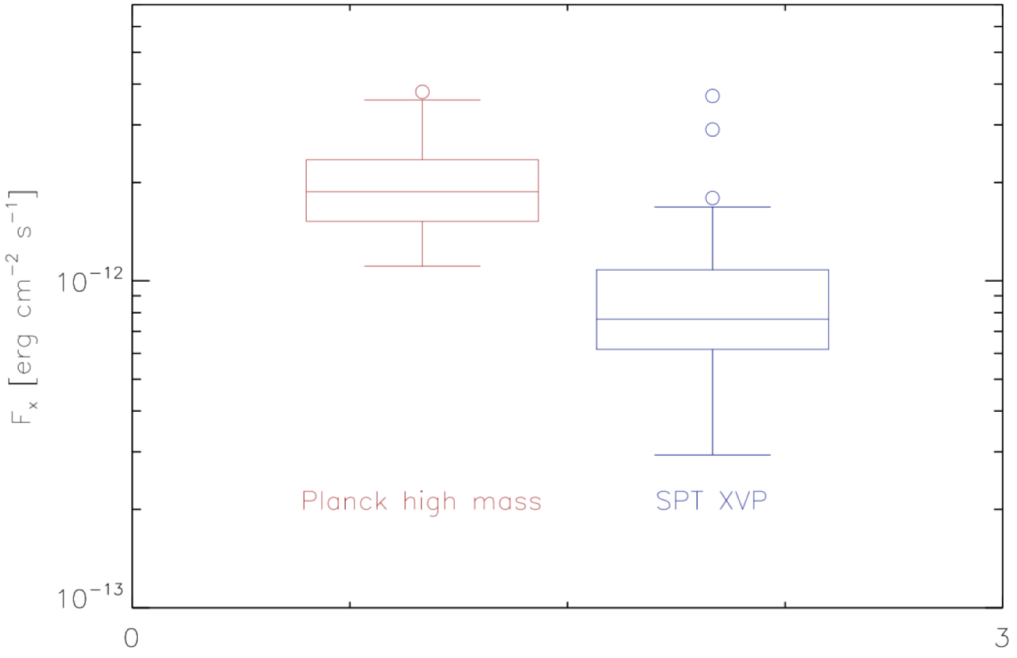
The Planck (SZ) legacy



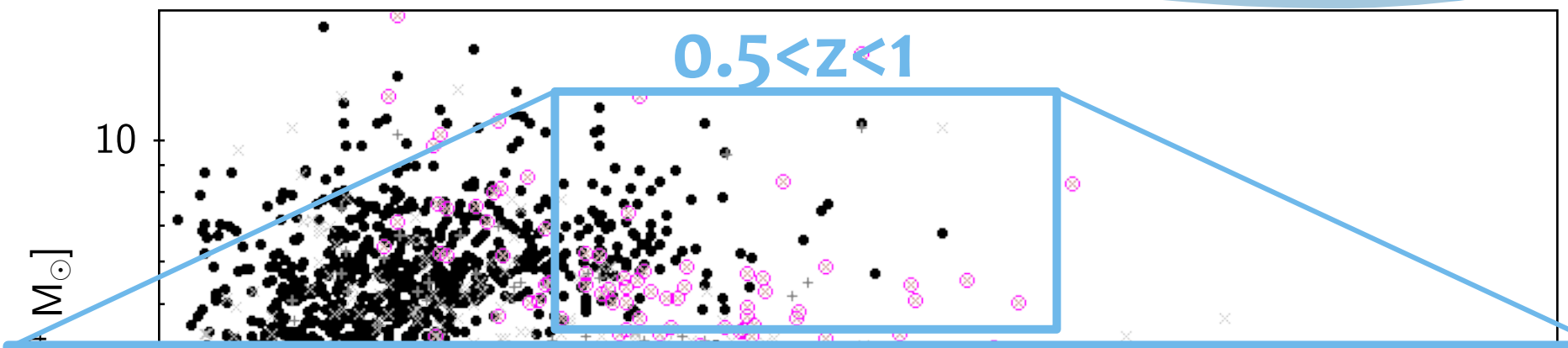
The Planck (SZ) legacy



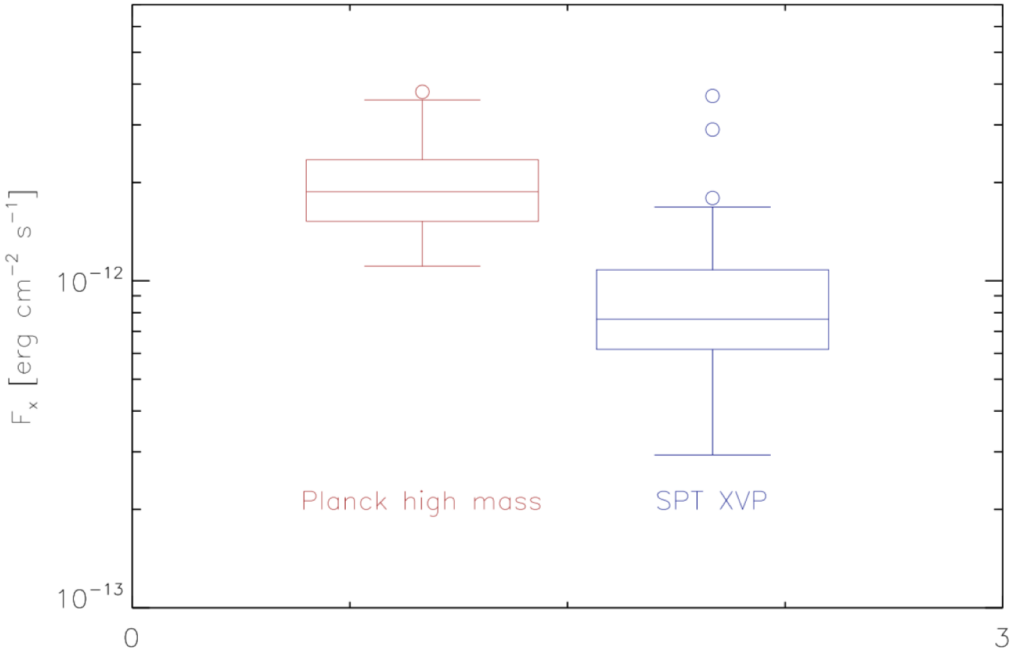




The Planck (SZ) legacy



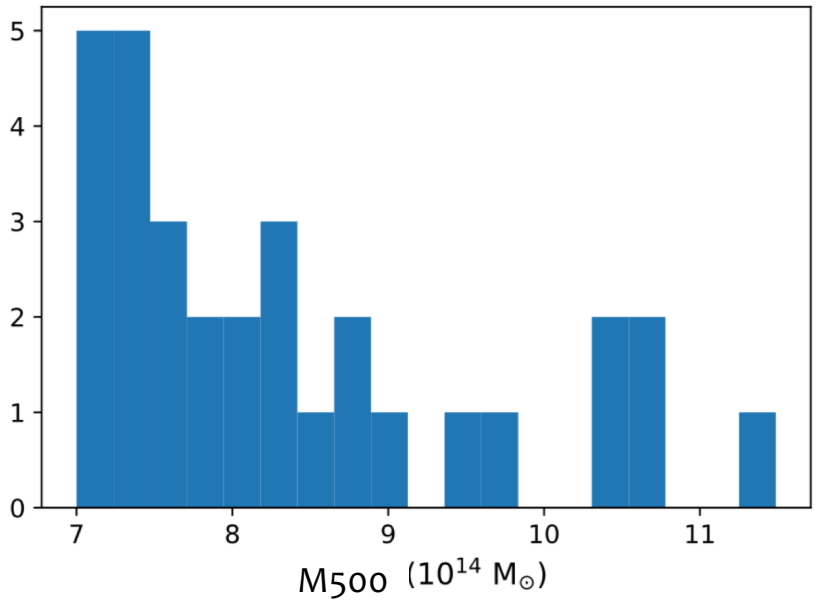
Planck clusters are more massive and X-ray brighter

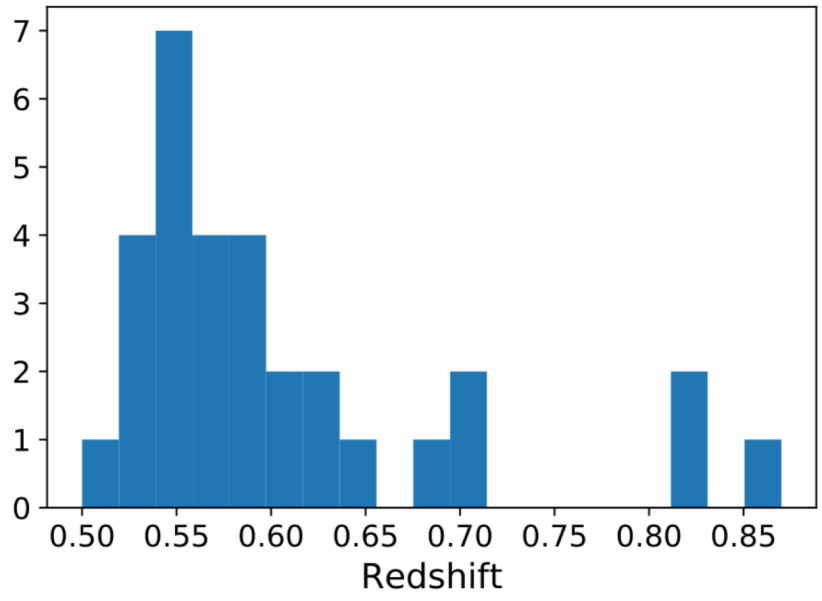


The Planck high-z high-M sample

31 PSZ2 detections with
M_{500}>7 10^{14} M_{sun} and z>0.5

16 Chandra snapshots to complete the sample





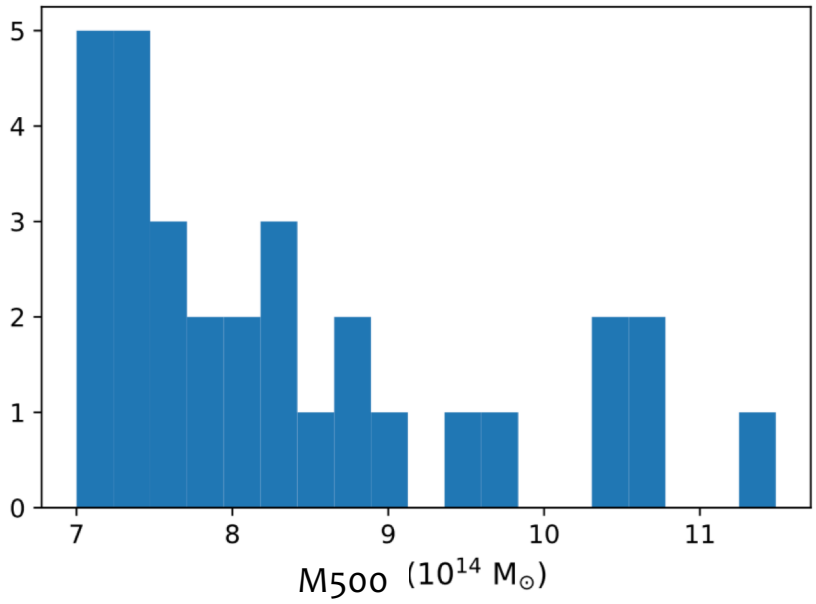
The Planck high-z high-M sample

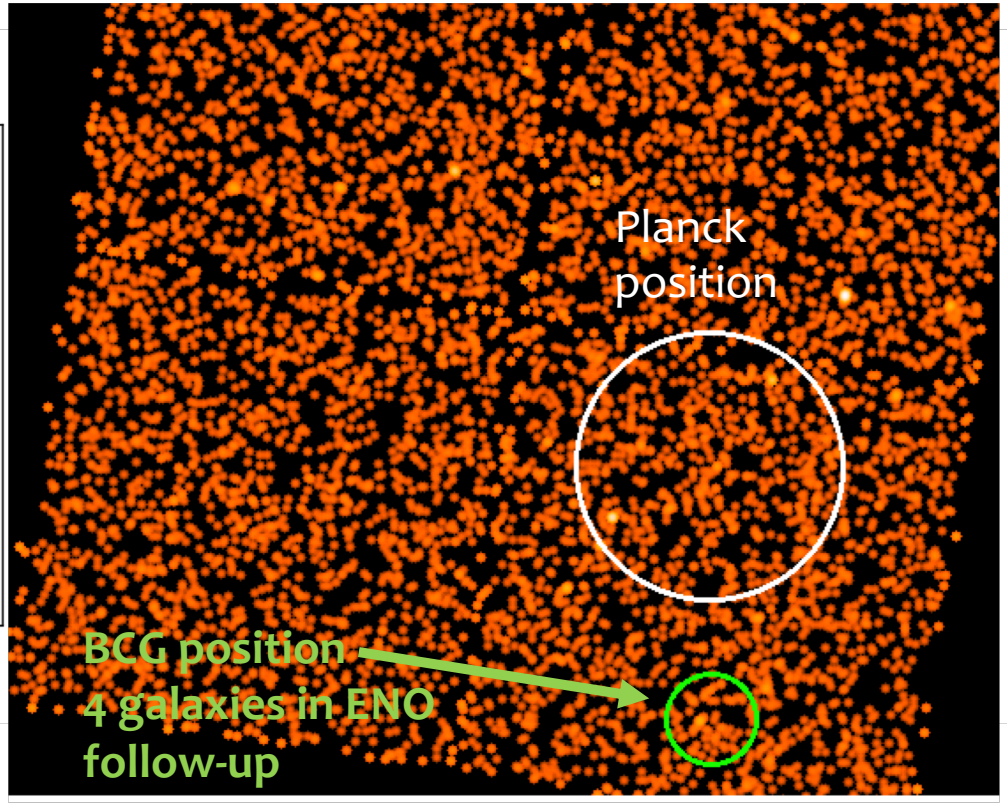
31 PSZ2 detections with $M_{500}>7\ 10^{14}\ M_{sun}$ and z>0.5

16 Chandra snapshots to complete the sample

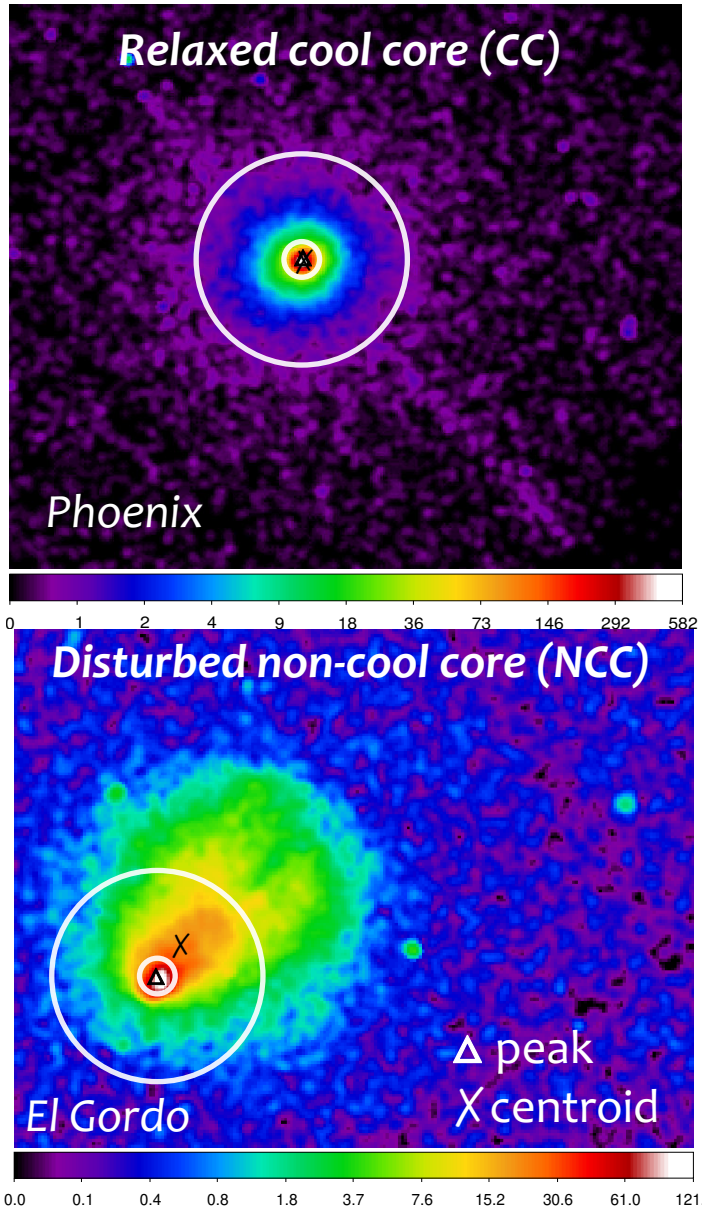
30 confirmed clusters, with X-rays

1 spurious detection





Dynamical state



We measured the dynamical state with two X-ray morphological indicators.

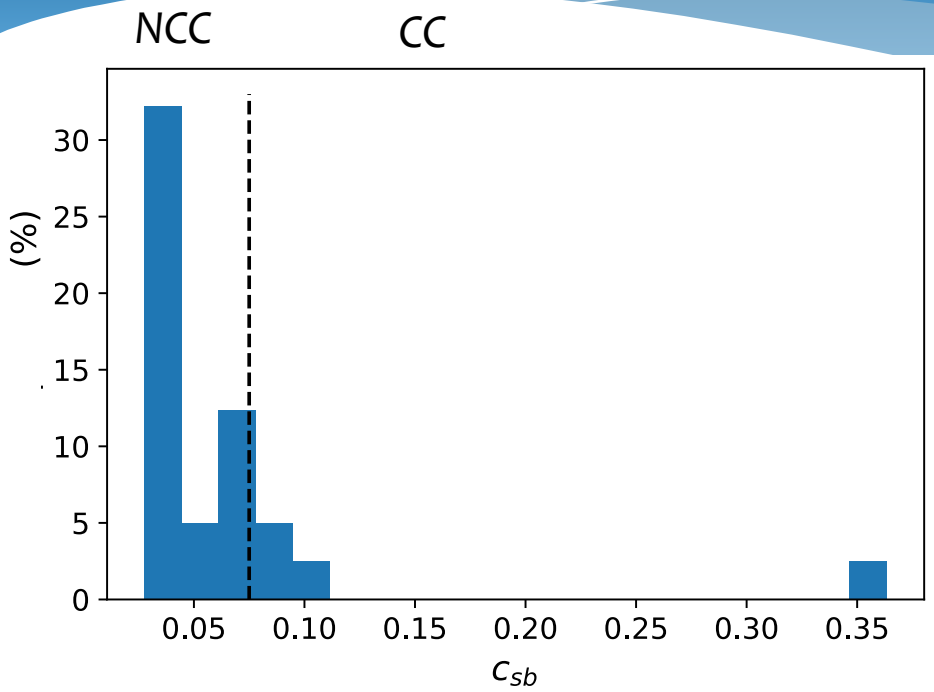
- Concentration parameter (Santos et al 2008, R_{IN}=40 kpc, R_{OUT}=400 kpc)

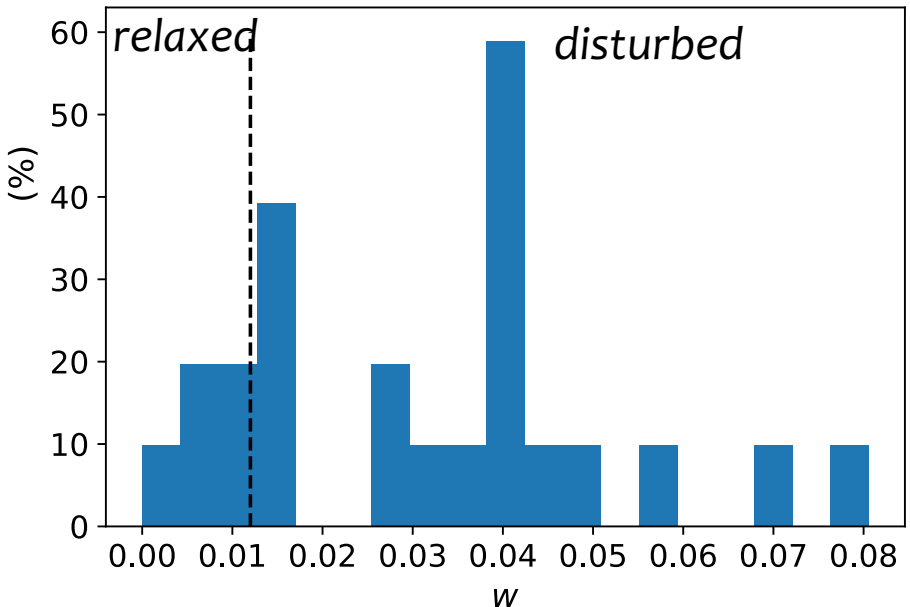
$$C_{SB} = \frac{I(R_{IN})}{I(R_{OUT})}$$

- Centroid shift within 500 kpc (e.g. Cassano et al 2010)

$$w = \left[\frac{1}{N-1}\sum_{i=1}^{N}(\Delta_i - \langle\Delta\rangle)^2\right]^{1/2} \times \frac{1}{500\ kpc}$$

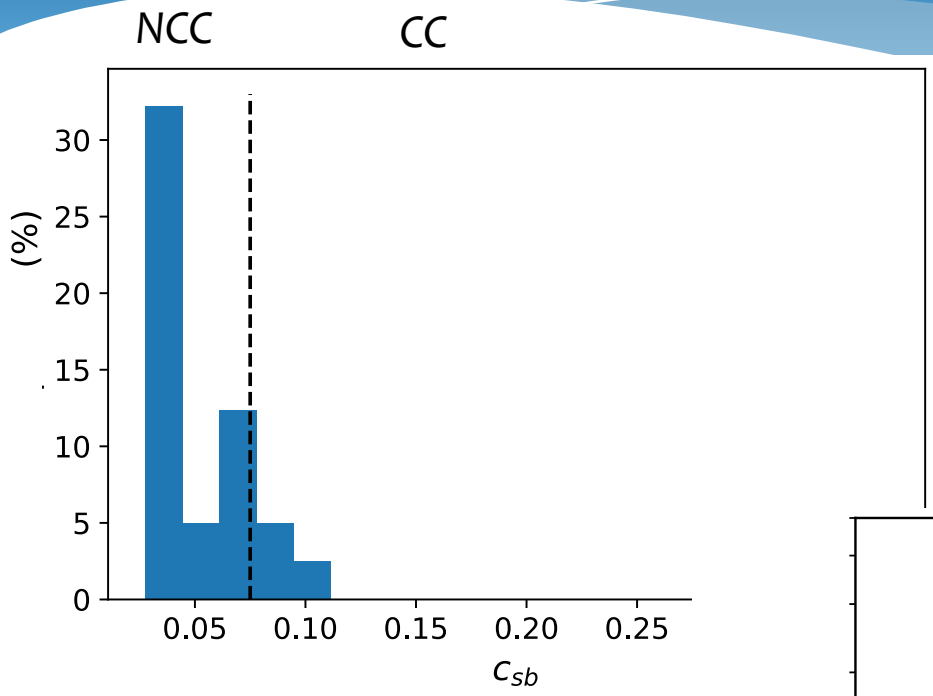
Dynamical state

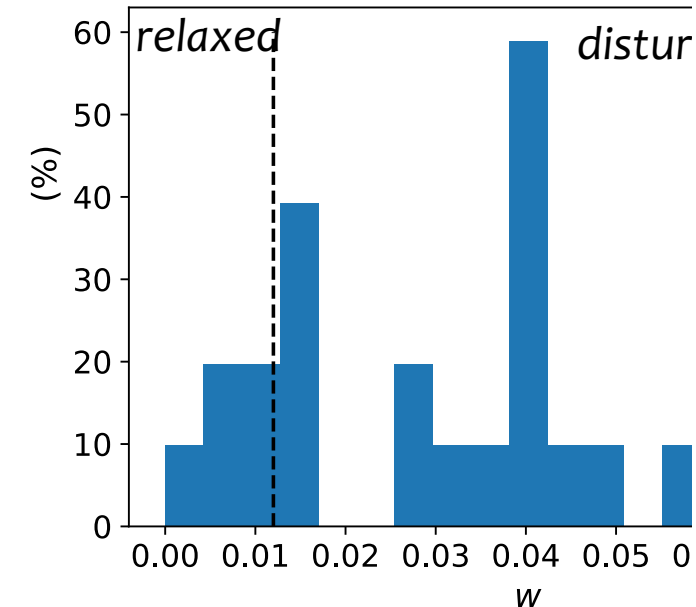




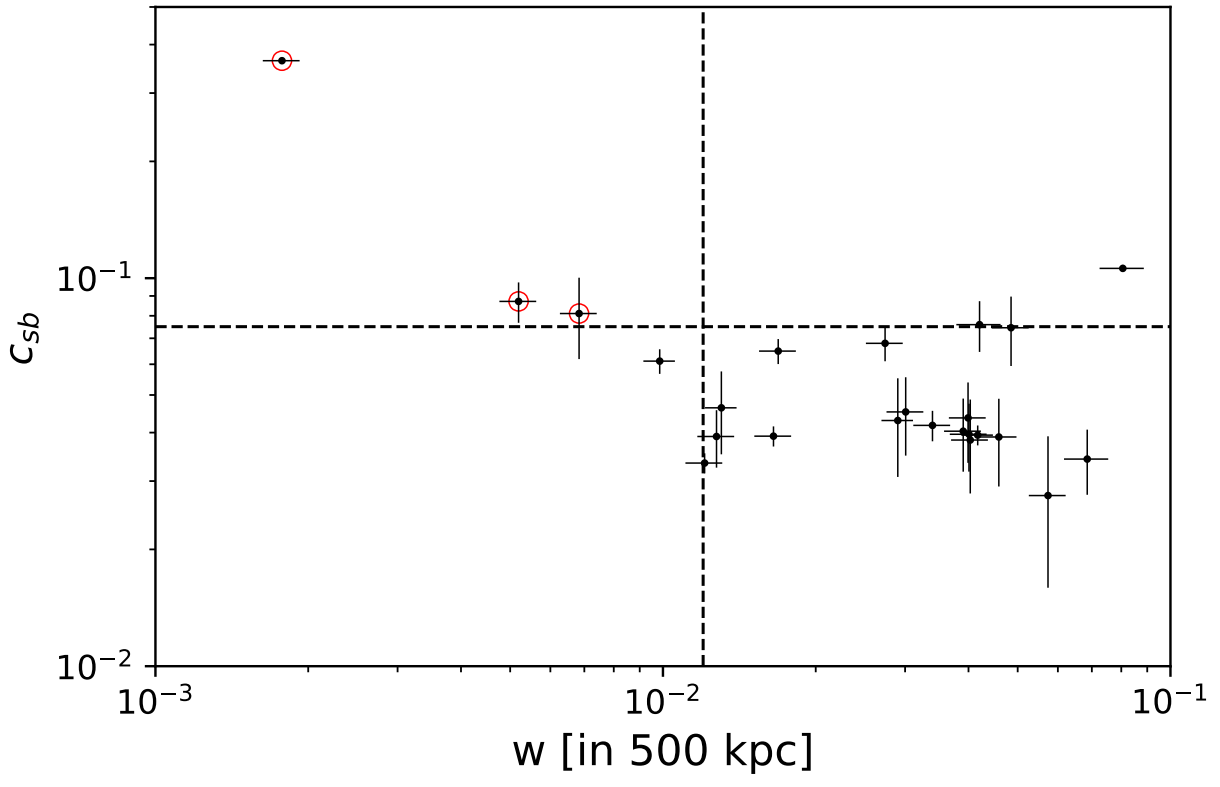
Most objects are disturbed non cool core systems

Dynamical state

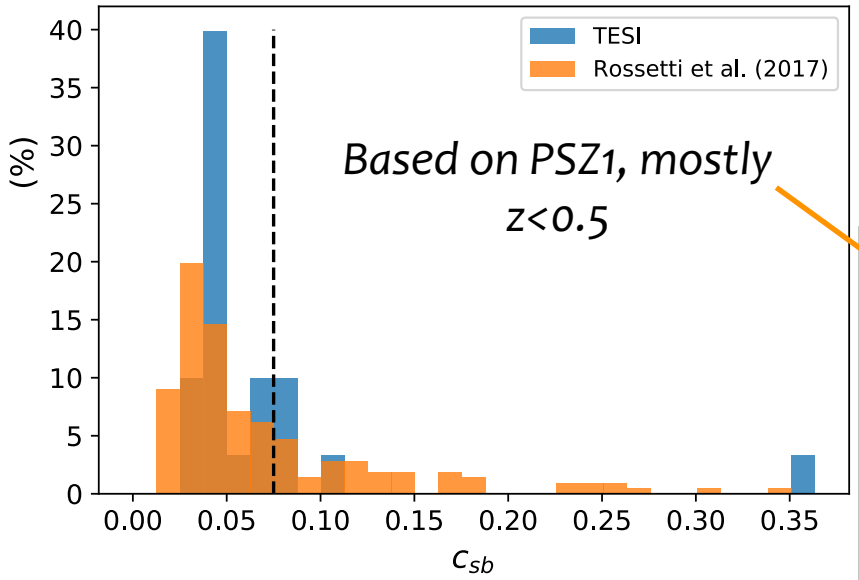




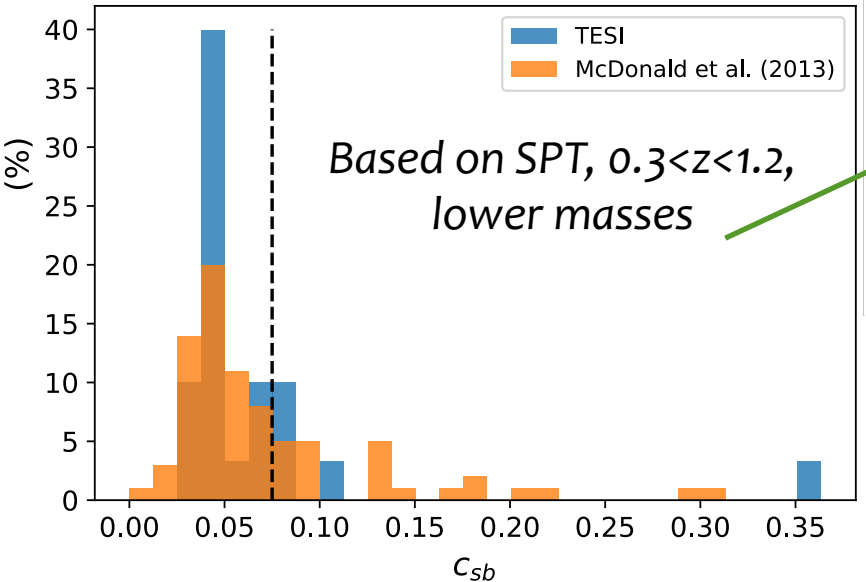
Most clusters are disturbed non cool core systems:
Only three candidate cool cores (one extreme)



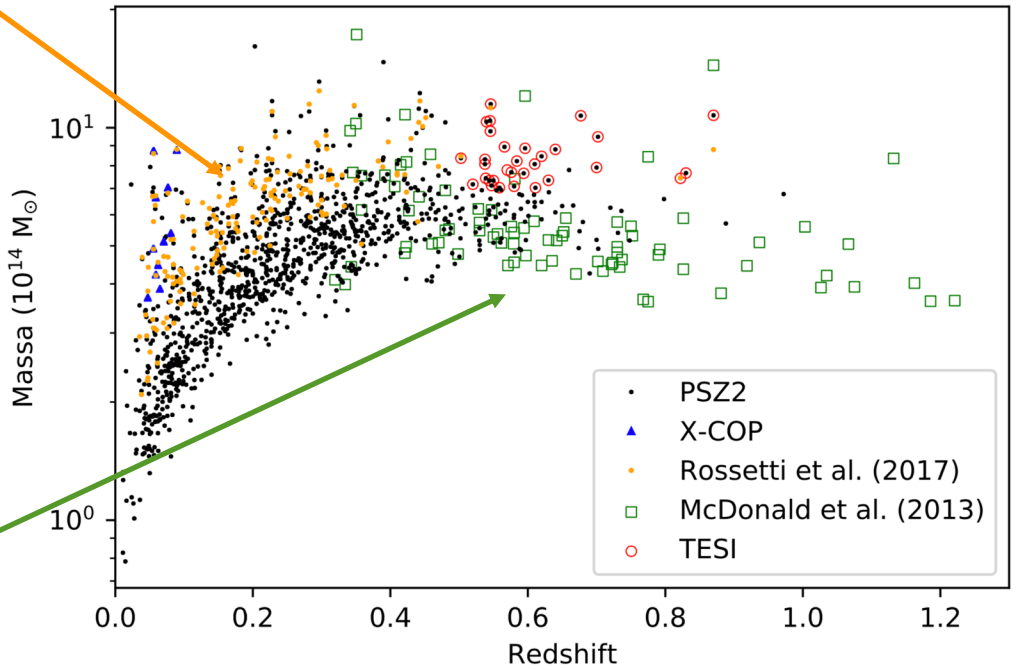
Dynamical state



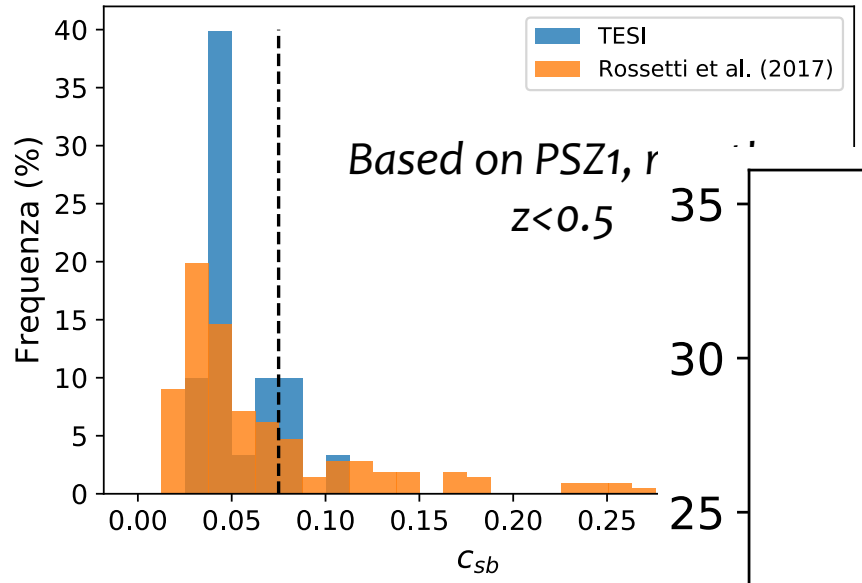
Based on PSZ1, mostly z<0.5

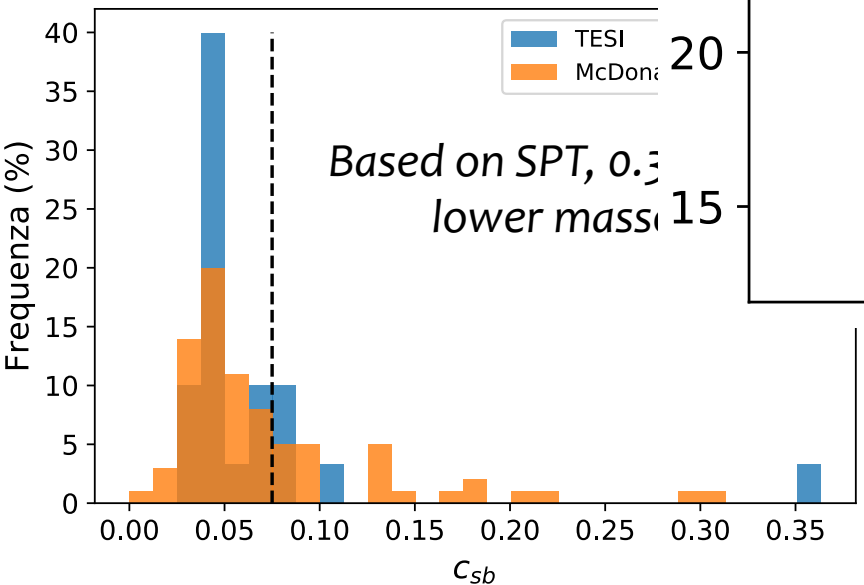


Based on SPT, 0.3<z<1.2, lower masses

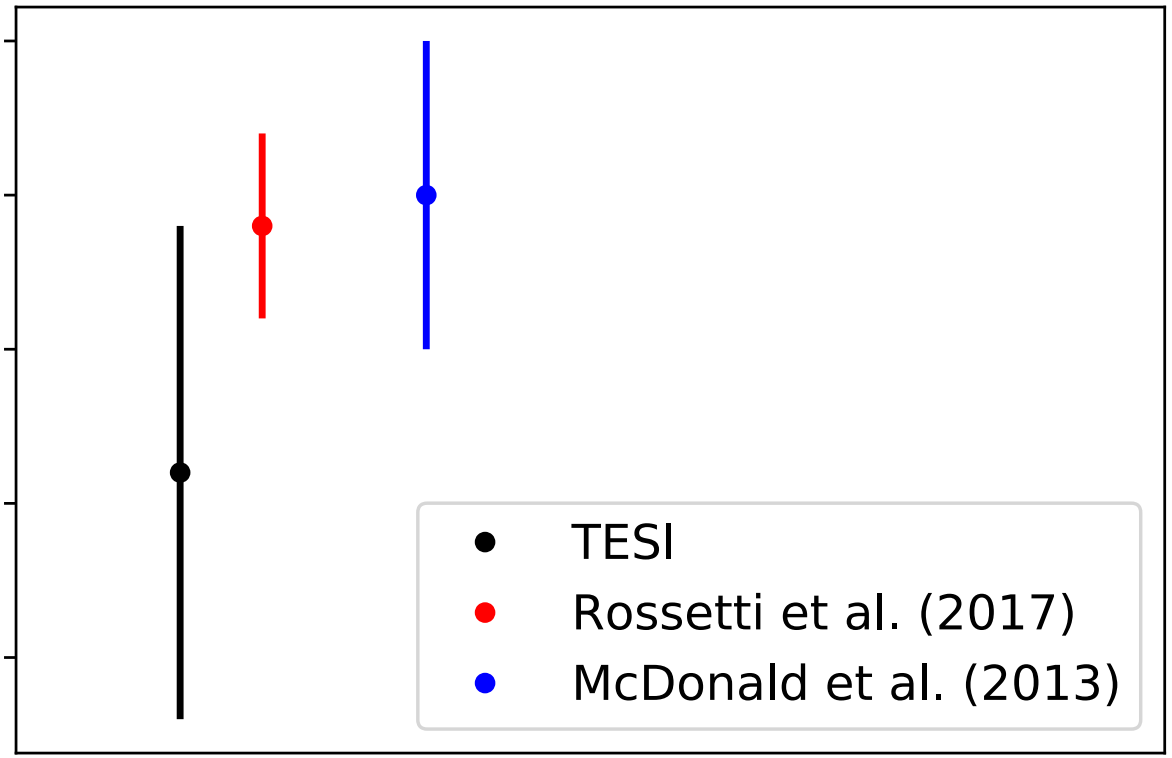


Dynamical state





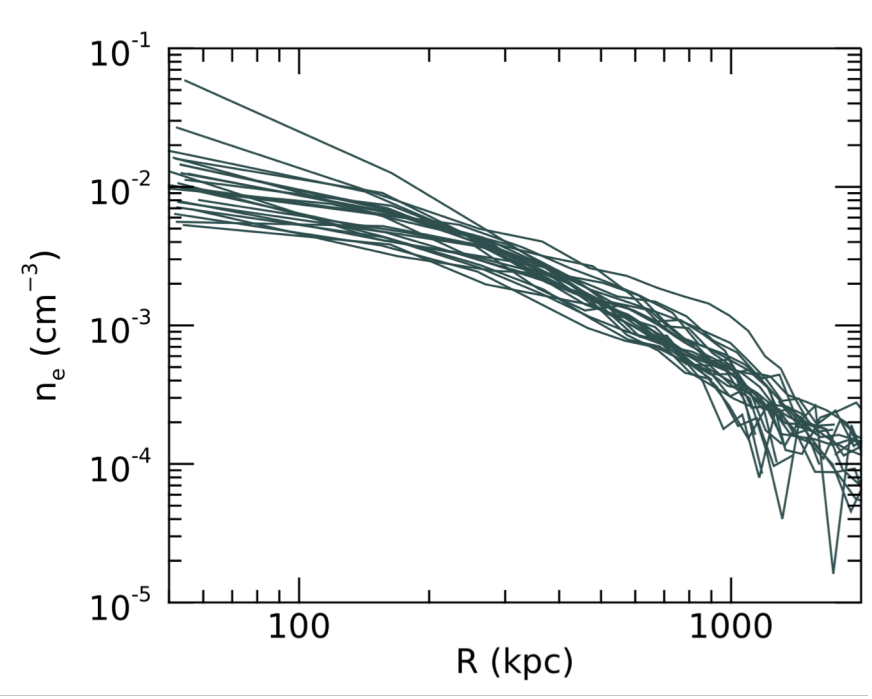
CC fraction (%)

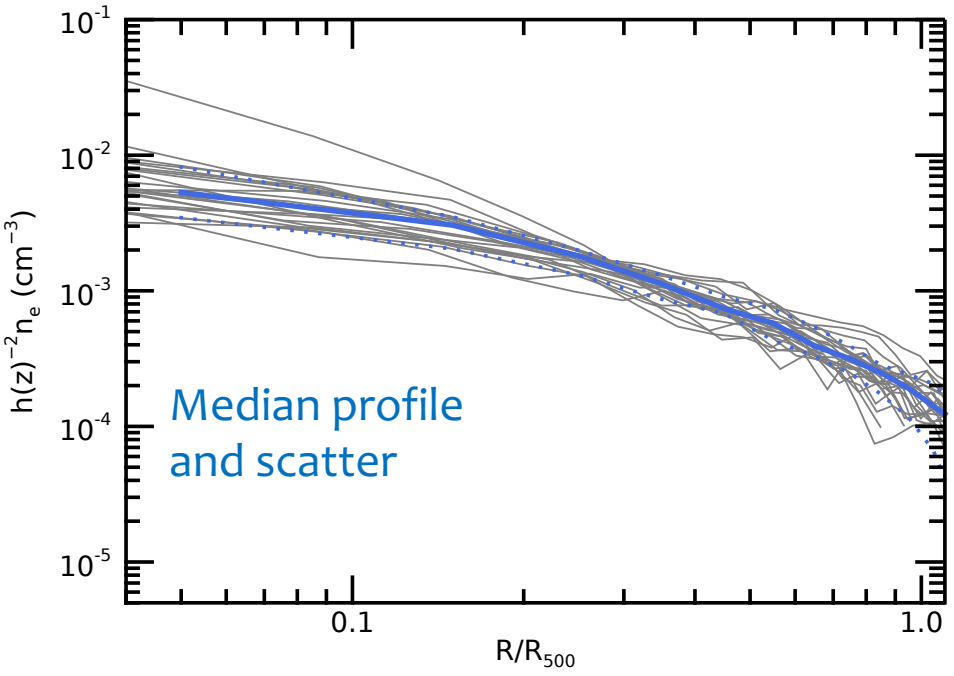


No significant indication of evolution (either in z or in M)

Density profiles

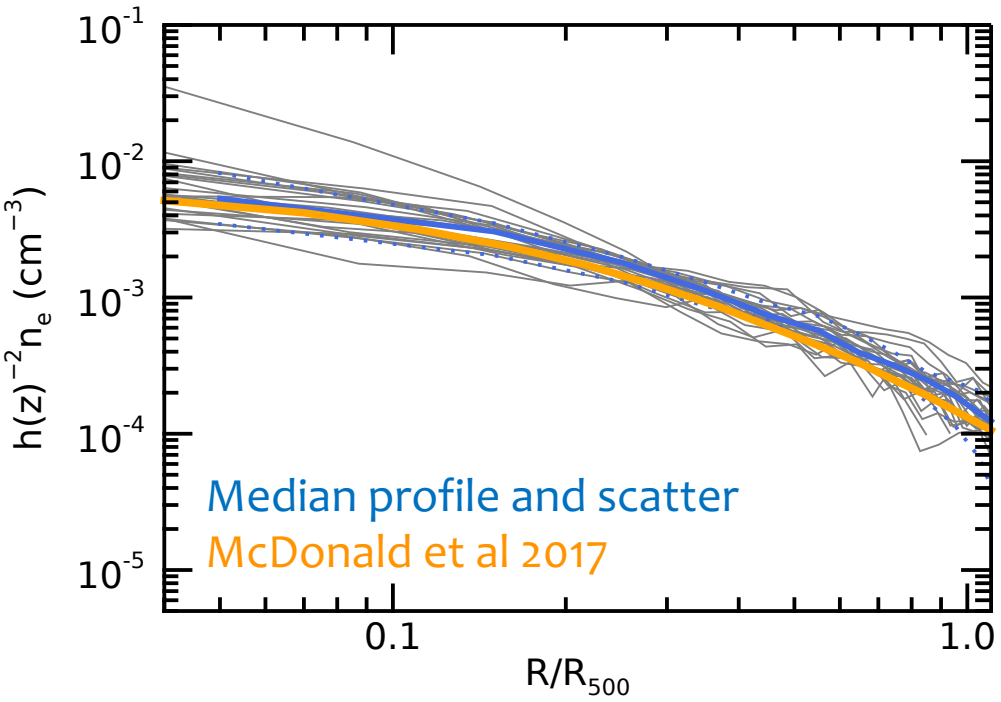
We extracted surface brightness and density profiles for our sample





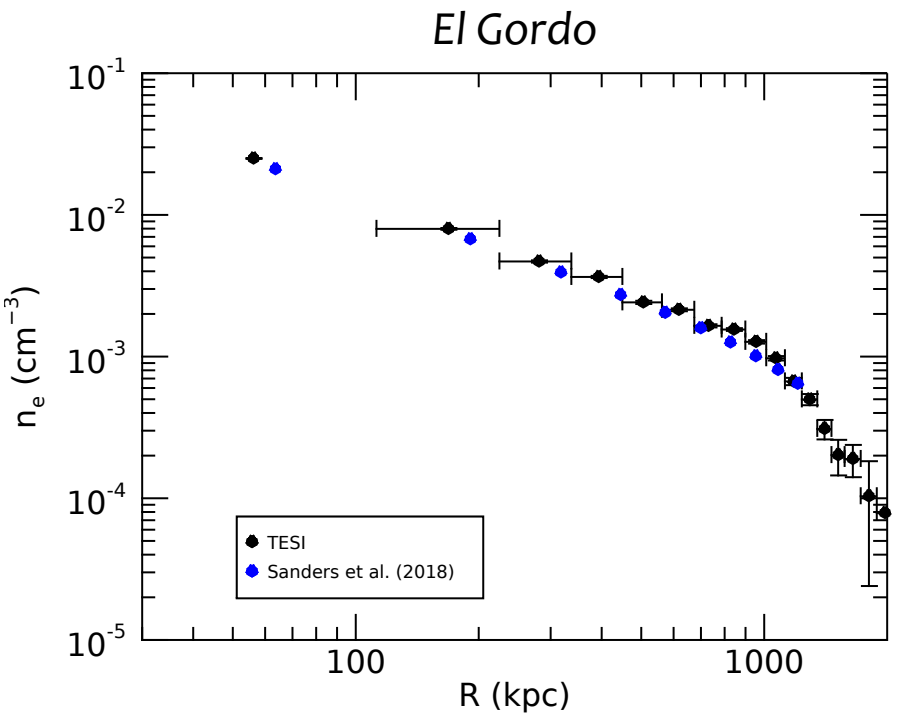
Self-similar rescaling based on M_{500} in PSZ2 catalogue

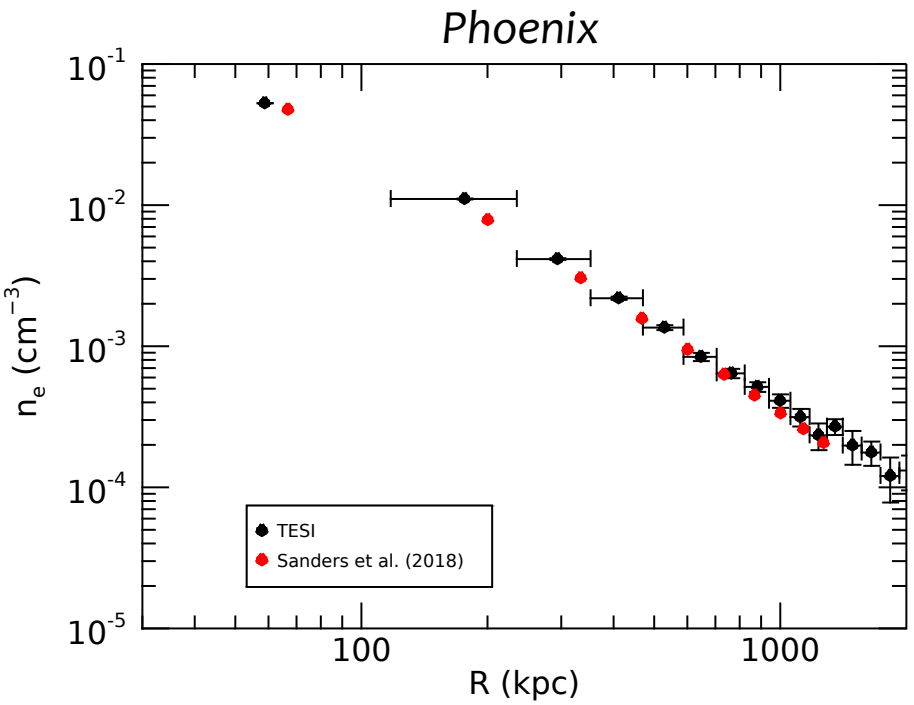
Density profiles



Comparison with median density profile for SPT clusters (McDonald et al 2017)
Significant differences in the median profiles

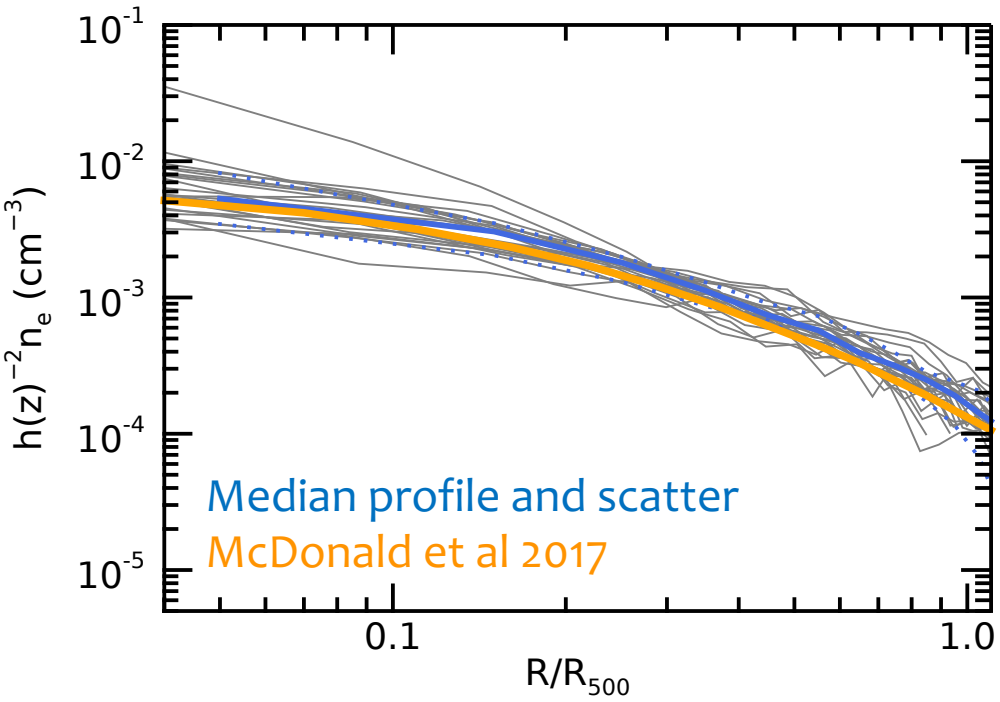
Some checks





Profiles in physical units for common systems are consistent:
Issue with rescaling?

Density profiles

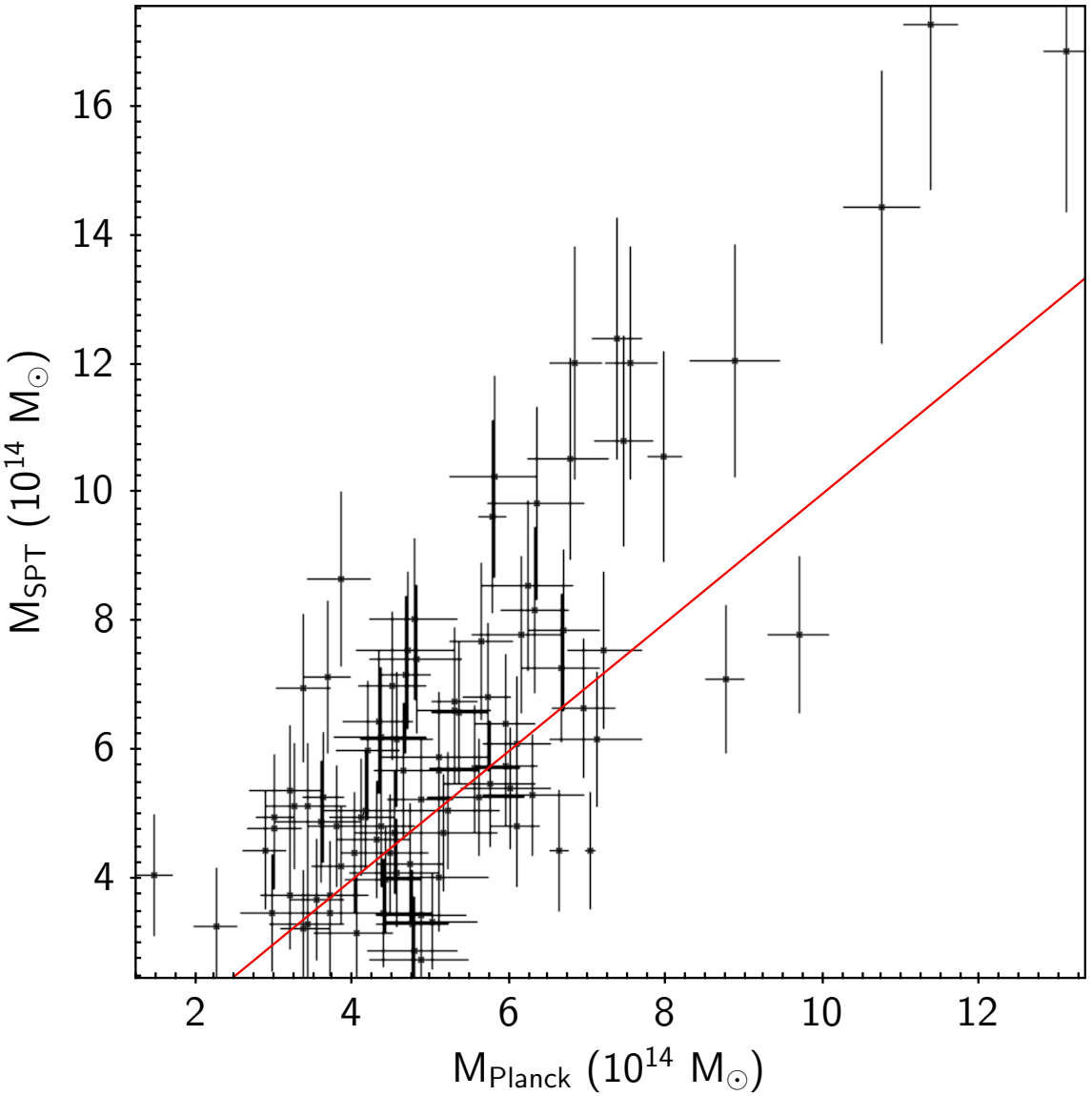


Comparison with median density profile for SPT clusters
(McDonald et al 2017)
Significant differences in the median profiles

Our self-similar rescaling based on M_{500} in PSZ2 catalogue
McDonald+2017 rescaling based on M_{500} in SPT catalogue

Are they consistent?

PSZ2 vs SPT masses

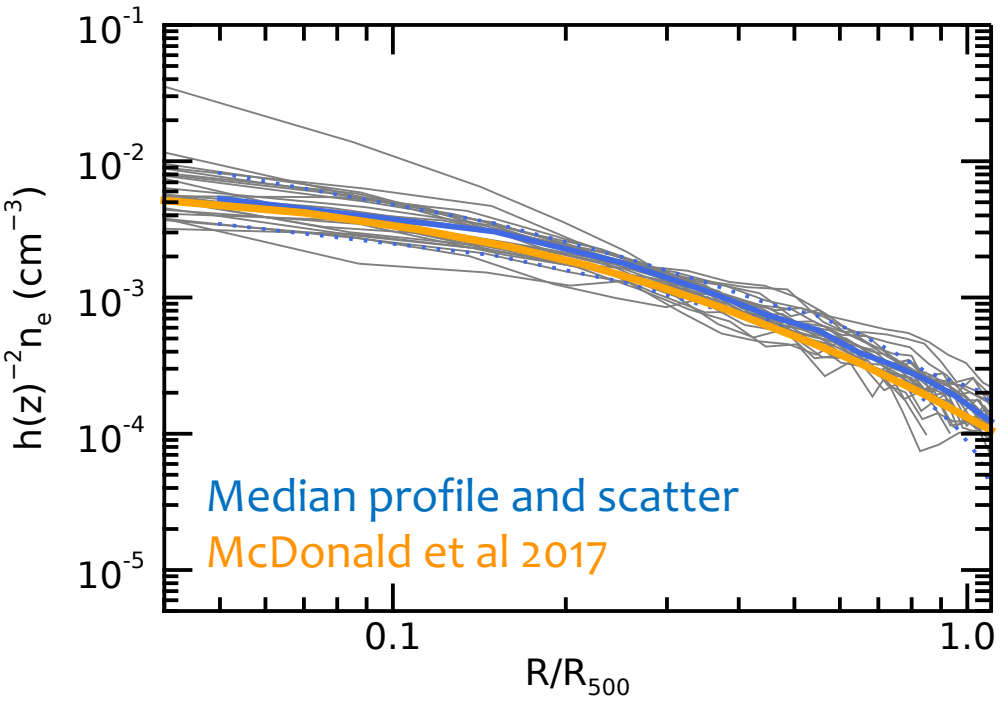


Planck Collaboration (2016) report 20% differences in masses between PSZ2 and SPT masses

For the two objects in common in our sample:

$$\frac{R_{SPT}}{R_{Planck}} \sim 1.13$$

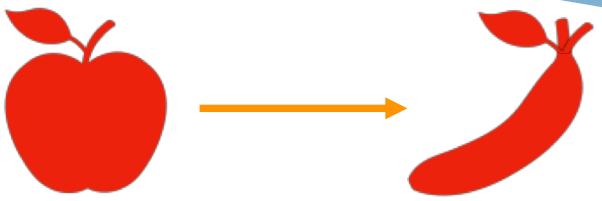
Density profiles

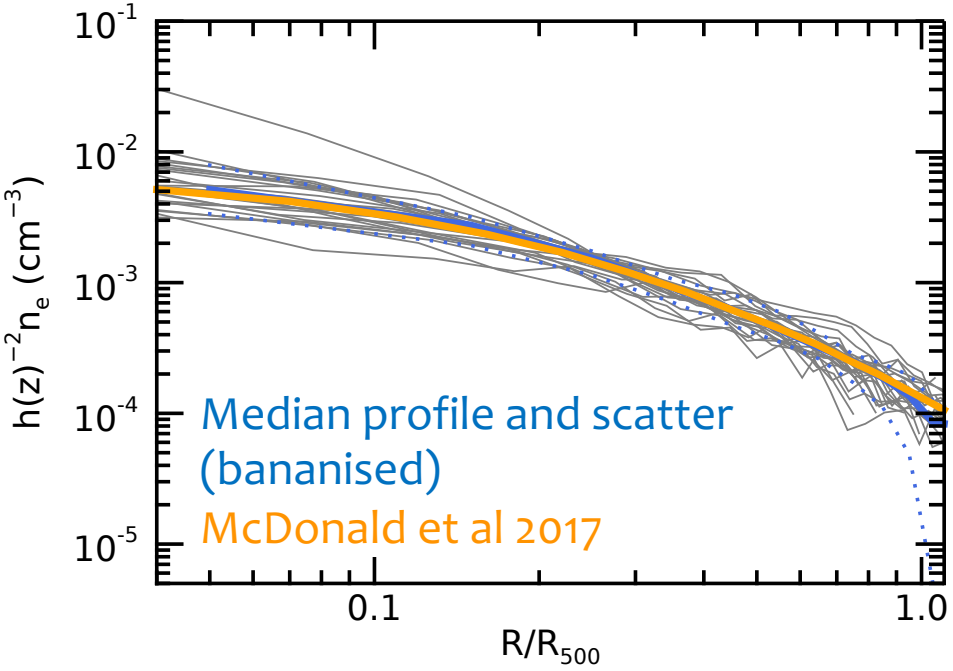


Comparison with median density profile for SPT clusters (McDonald et al 2017)
Significant differences in the median profiles

Our self-similar rescaling based on M_{500} in PSZ2 catalogue
McDonald+2017 rescaling based on M_{500} in SPT catalogue
We are comparing

Density profiles



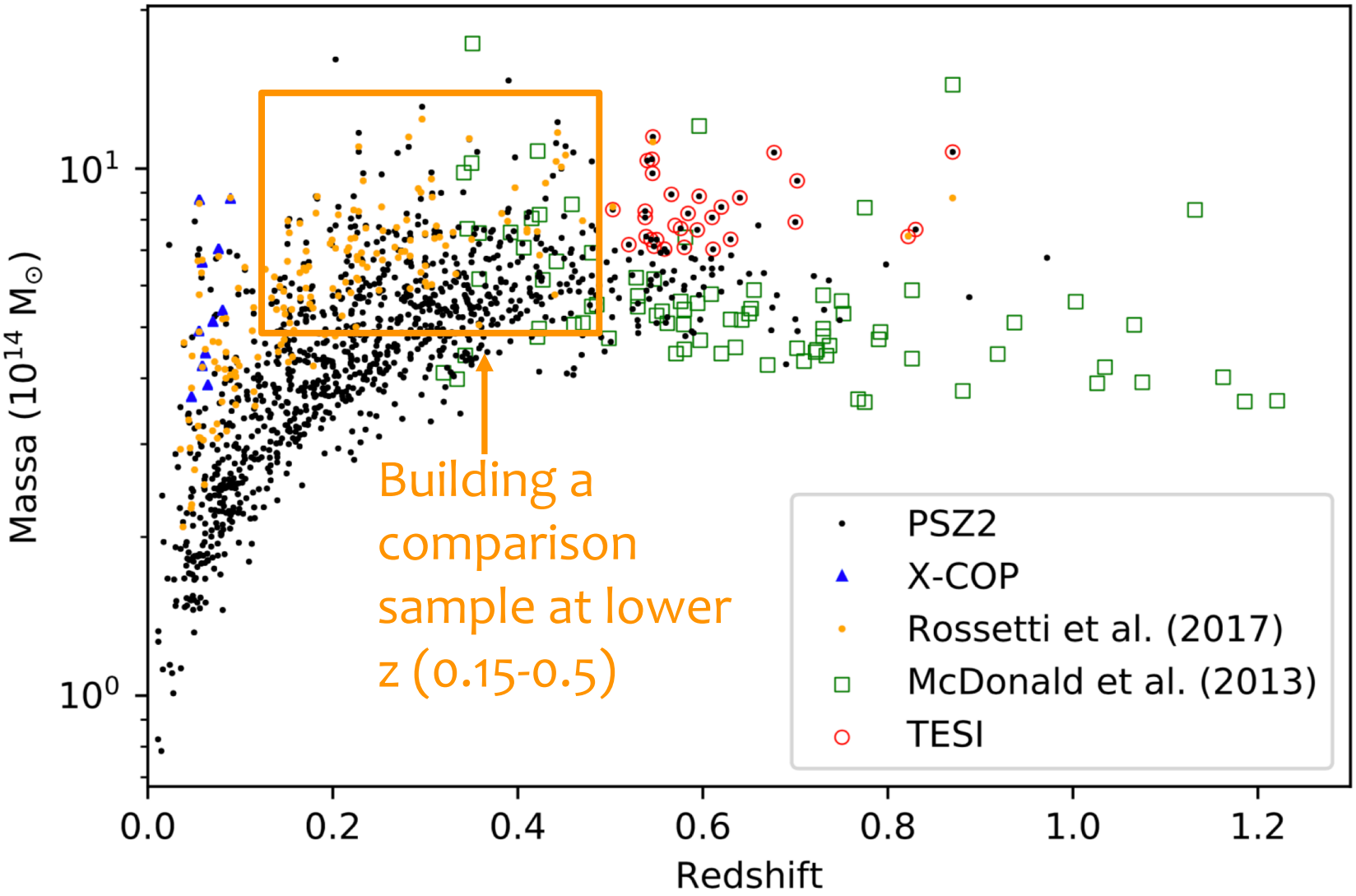


Correction of this systematic difference by assuming the ratio found in the common systems

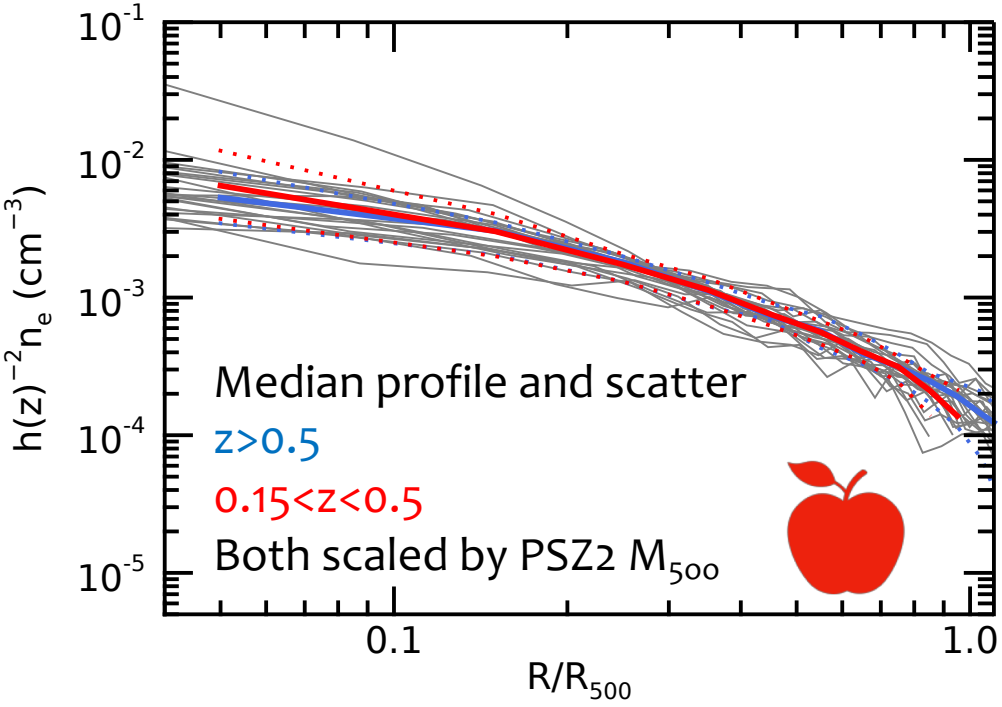
$$\frac{R_{SPT}}{R_{Planck}} \sim 1.13$$

Mean density profiles are consistent for the two samples with different mass range

Density profiles



Density profiles



Analysis and rescaling performed in the same way

PRELIMINARY

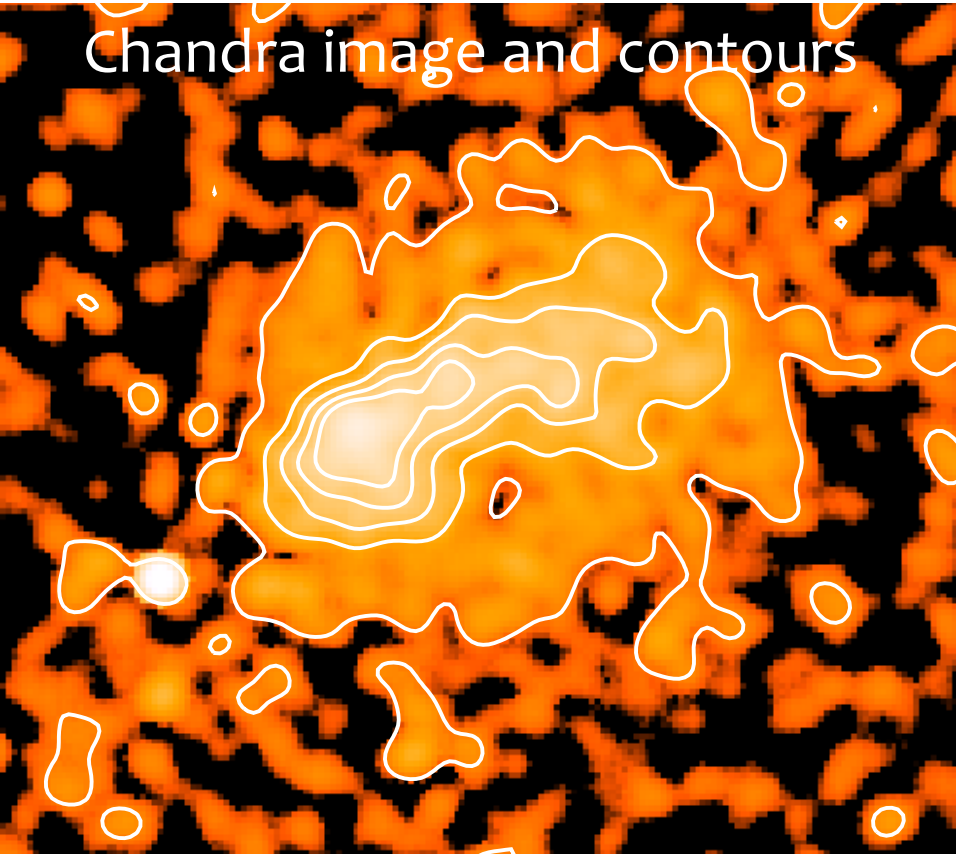
Mean density profiles are consistent for the two samples with different redshift range:

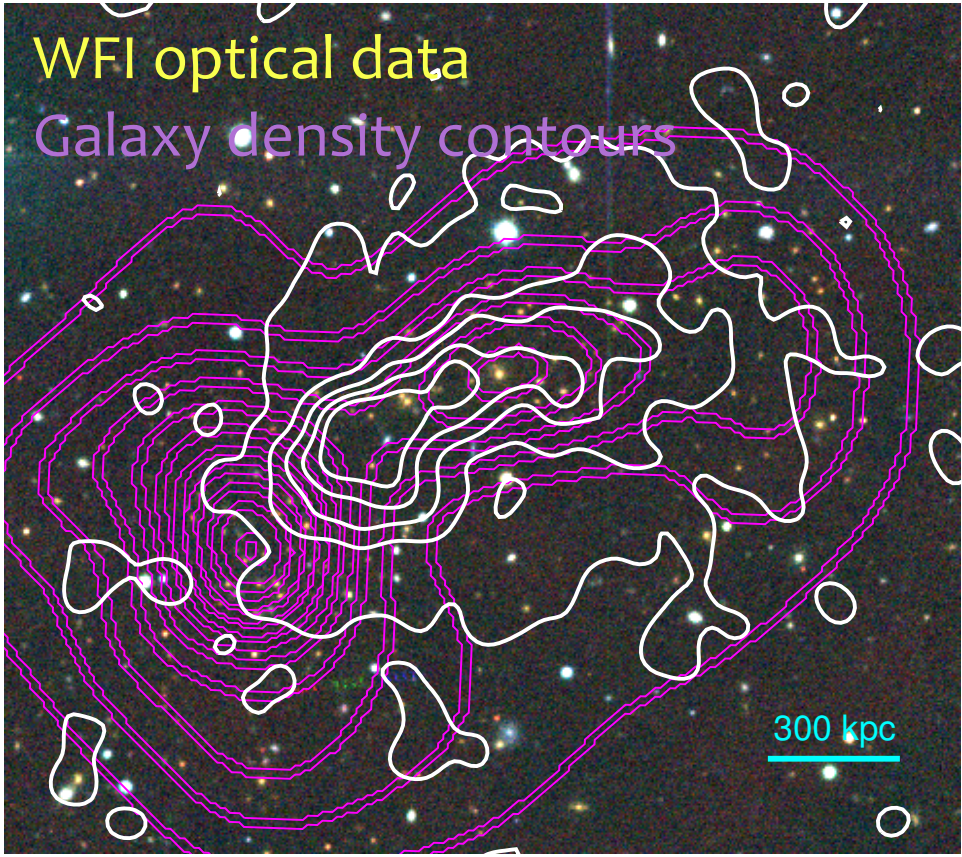
No indication of evolution in density profiles from z=0.15 up to z=1

Except than in the cores? (see also McDonald 13,17)

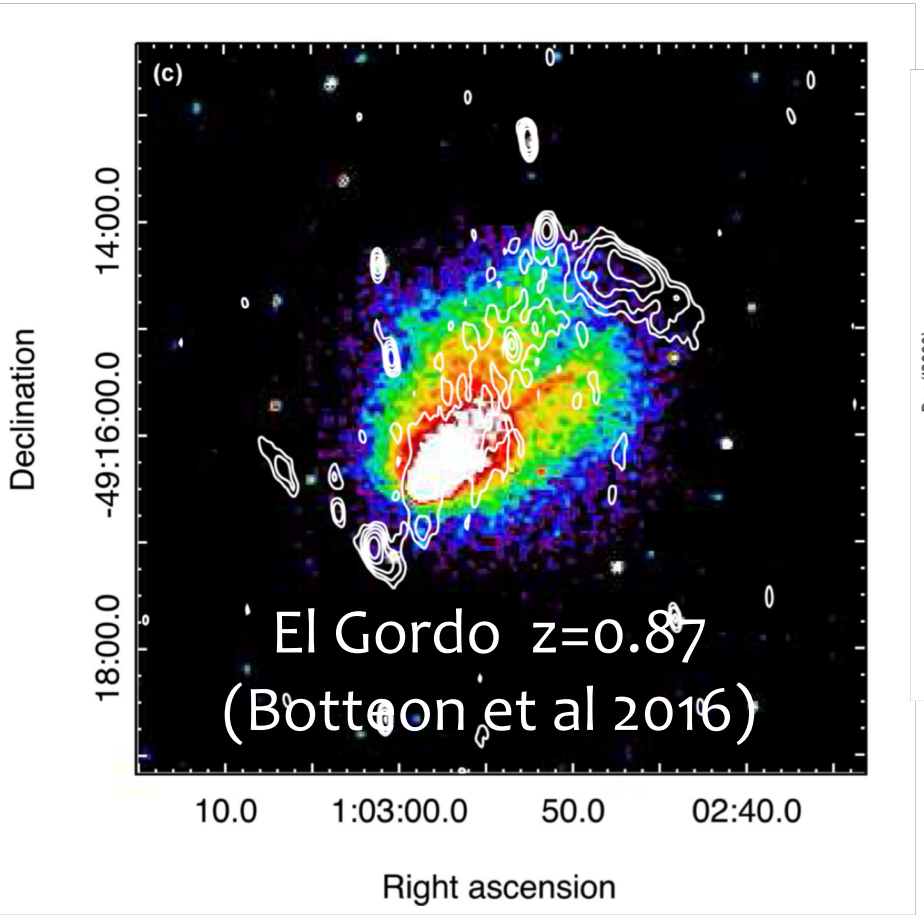
An interesting cluster

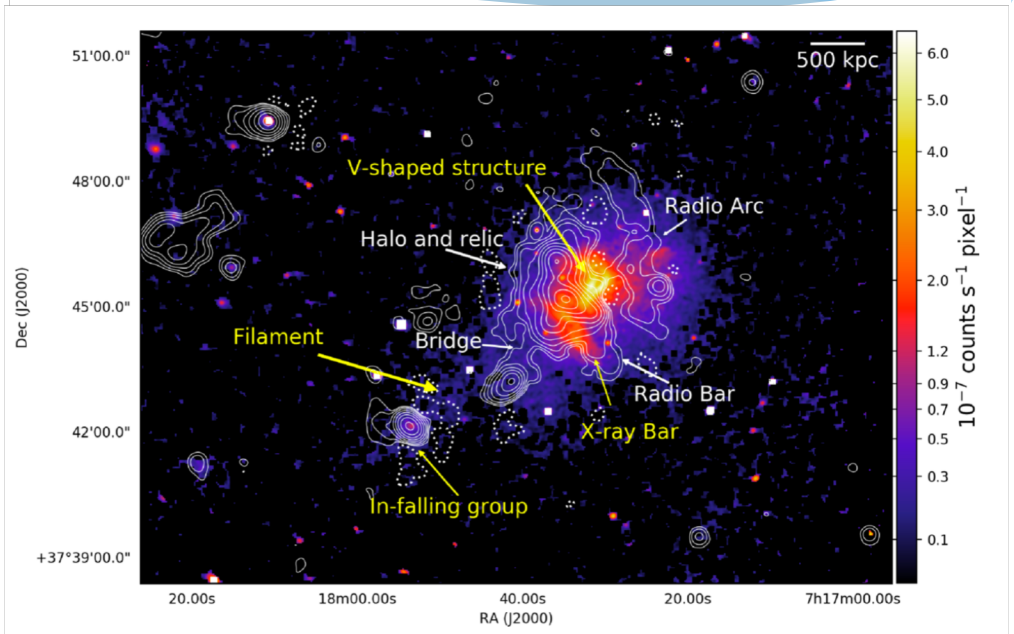
Some clusters observed in X-rays for the first time
350 kpc separation btw X-ray peak and galaxy concentration:
a new bullett cluster?





Not only X-rays





PSZ2G180.25+21.03 z=0.55
(Bonafede et al 2018)

Radio features (halos, relics) are common also at high-z
LOFAR is also looking at massive clusters (stay tuned!)
X-rays and high-resolution SZ provide a necessary complementary view

Conclusions and prospects for NIKA2

- A new Planck-selected sample with the 30 most massive clusters at z>0.5, followed up in X-rays
- Morphological indicators show that they are mostly disturbed NCC objects
- No clear indication of deviations from self-similar evolution either in z or in M

Some of them already observed with NIKA2!
Joint X-ray + SZ + radio (LOFAR) analysis can provide many information on the physics of these systems.
Shocks at relics?

Thanks!