

# PRESSURE PROFILES OF GALAXY CLUSTERS USING PLANCK AND ACT



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Illust.: Hurier, Douspis, Aghanim Data: Planck ESA/HFI/LFI

# The PACT project

## Planck-ACT project : "SZ clusters in the Planck era"

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### Motivations

1. Improved our understanding of the SZ view of galaxy clusters,
2. allow the community to improve cosmological constraints by reducing the amount of modeling uncertainties
3. help in defining the prospects for future CMB space or ground-based missions in terms of SZ science.

### Two approaches

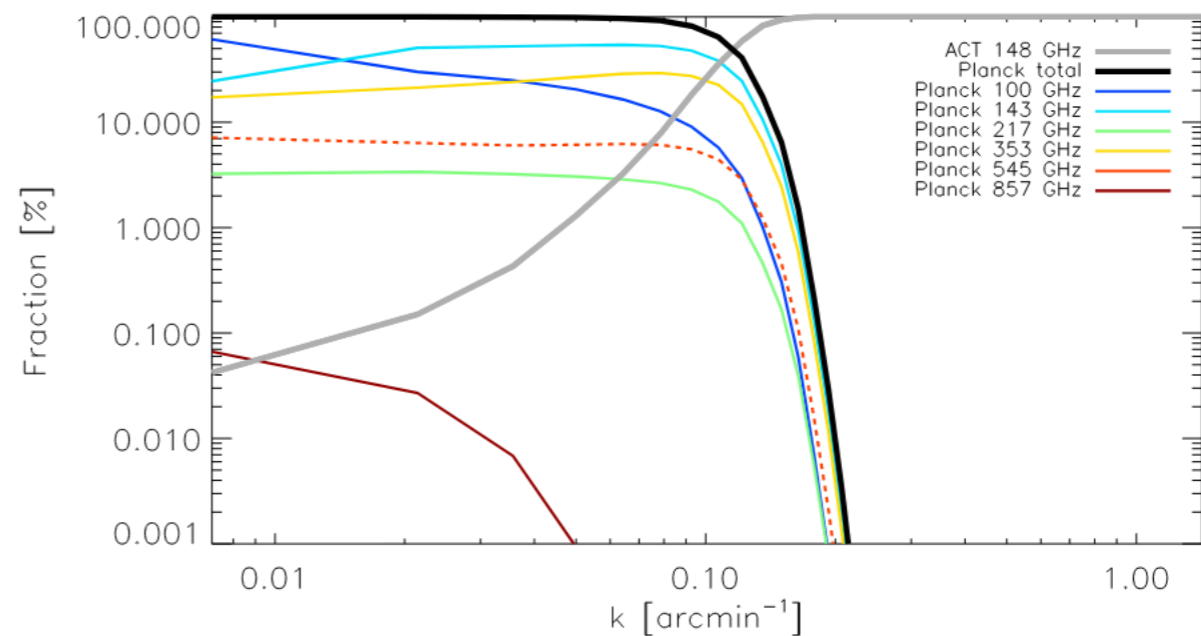
1. MMF focused on the detection of tSZ clusters
2. tSZ y-map based on Internal Linear Combination techniques.

# The PACT SZ map

Combining the frequency maps from

- Planck/HFI full sky mission maps (Planck Collaboration VIII 2016)
- ACT MBAC (southern and autodial strips)

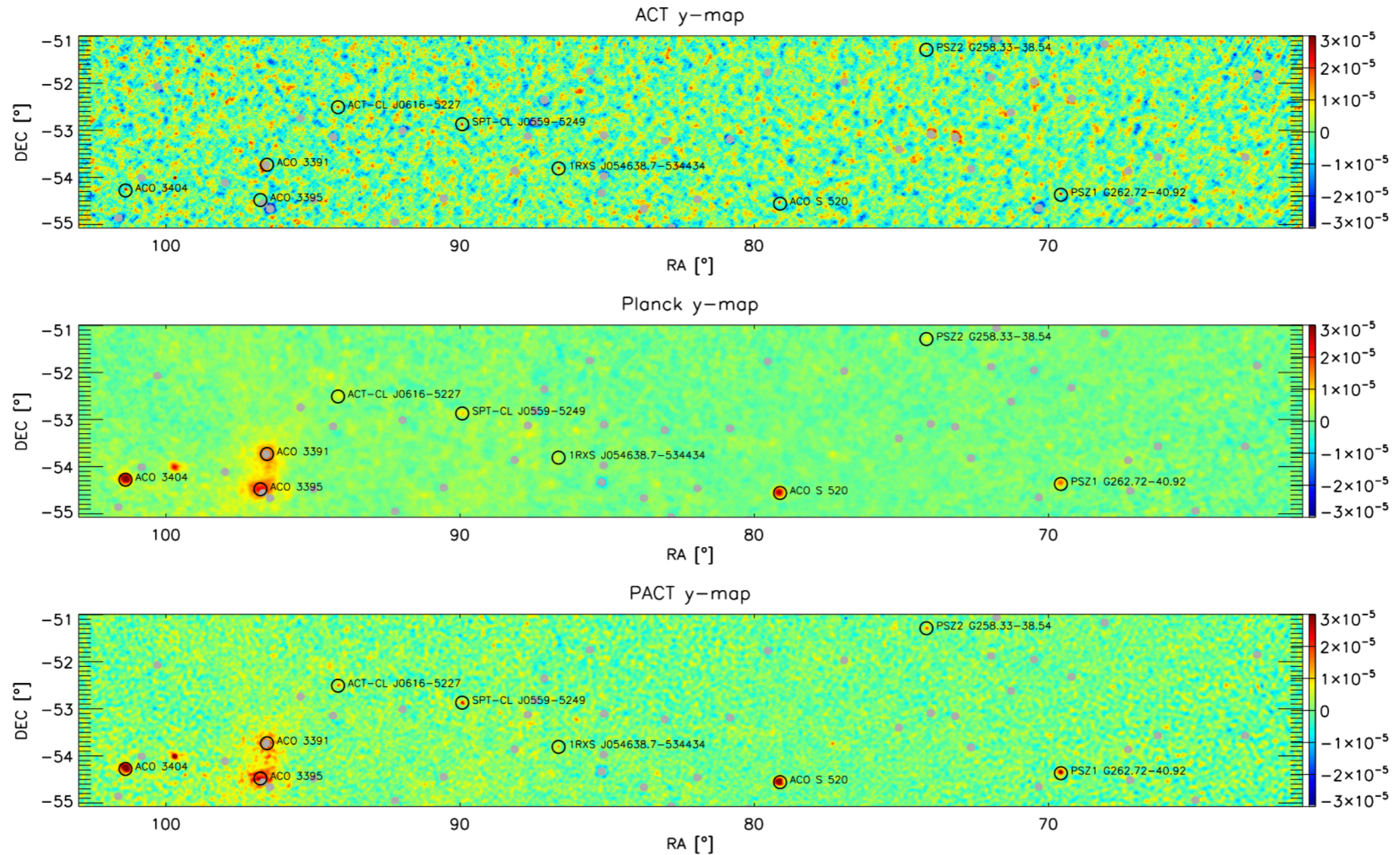
	Frequency [GHz]	FWHM [arcmin]	$g(\nu) T_{\text{CMB}} [K_{\text{CMB}}]$
<i>Planck</i>	100	9.68	-4.03121
	143	7.30	-2.78564
	217	5.02	0.18763
	353	4.94	6.20518
	545	4.83	14.45559
	857	4.64	26.33521
ACT	148	1.374	-2.69100
	220	1.053	0.10400



Frequency maps used and relative weights (as a function of scales) to the reconstructed PACT y-map

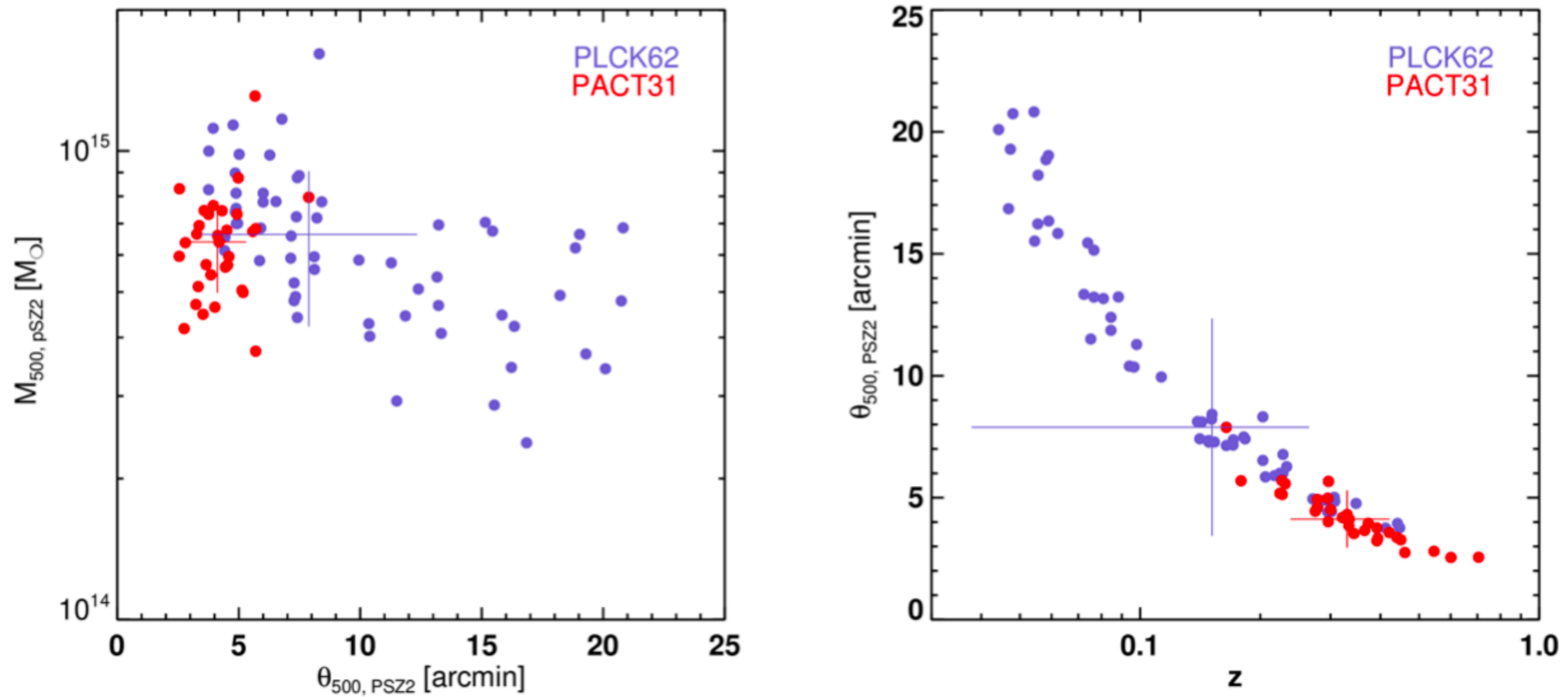
(Aghanim et al. 2019,  
see also Remazeilles et al. 2013, Hurier et al. 2014)

# The PACT SZ maps



ACT (top), Planck(middle) and PACT (bottom) y-maps  
(Aghanim et al. 2019)

# Sample



PACT31 (red dots) vs PLCK62 (blue dots)

**PACT31 – 31 clusters detected by both Planck and ACT**

13 in the southern strip ; 18 in the equatorial strip

$0.16 < z < 0.7$  ;  $3.7 \times 10^{14} < M_{500} < 1.3 \times 10^{15} M_{\odot}$

**PLCK62 – 62 clusters selected from ESZ and XMM archives**

(Planck Coll. Early Results XI 2011)

# Validation & cross-checks

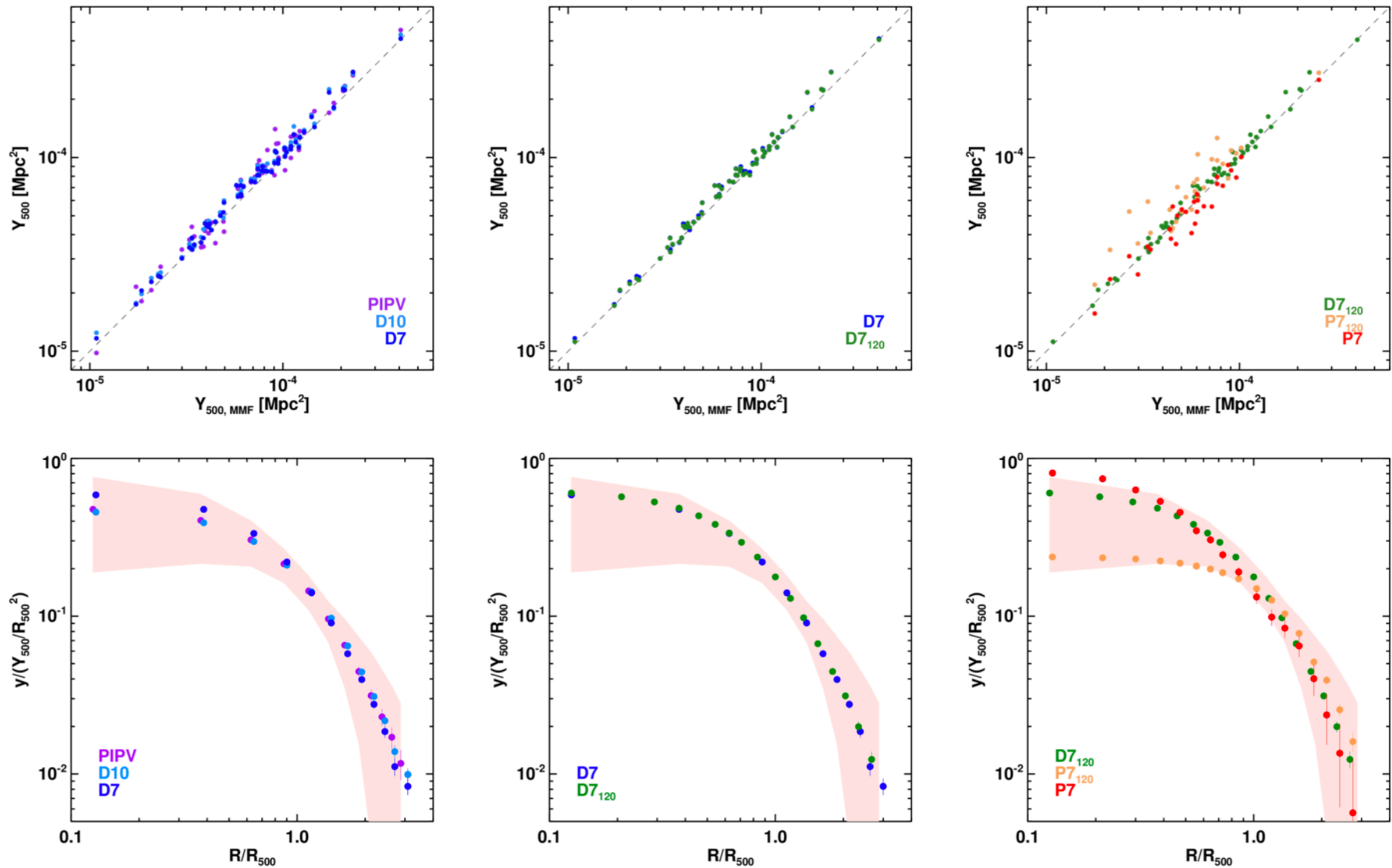
PLCK62 – 62 clusters selected from ESZ and XMM archives

PACT31 – 31 clusters detected by Planck and ACT in the ACT-MBAC footprints

Name	Sample	y-map	FWHM	$\Delta r/R_{500}$
PIPV	PLCK62	PC-internal	10 arcmin	0.25
D10	PLCK62	DR2015	10 arcmin	0.25
D7	PLCK62	DR2015	7 arcmin	0.25
D7 <sub>120</sub>	PLCK62	DR2015	7 arcmin	0.08
P7 <sub>120</sub>	PACT31	DR2015	7 arcmin	0.08
P7	PACT31	PACT	1.4 arcmin	0.08

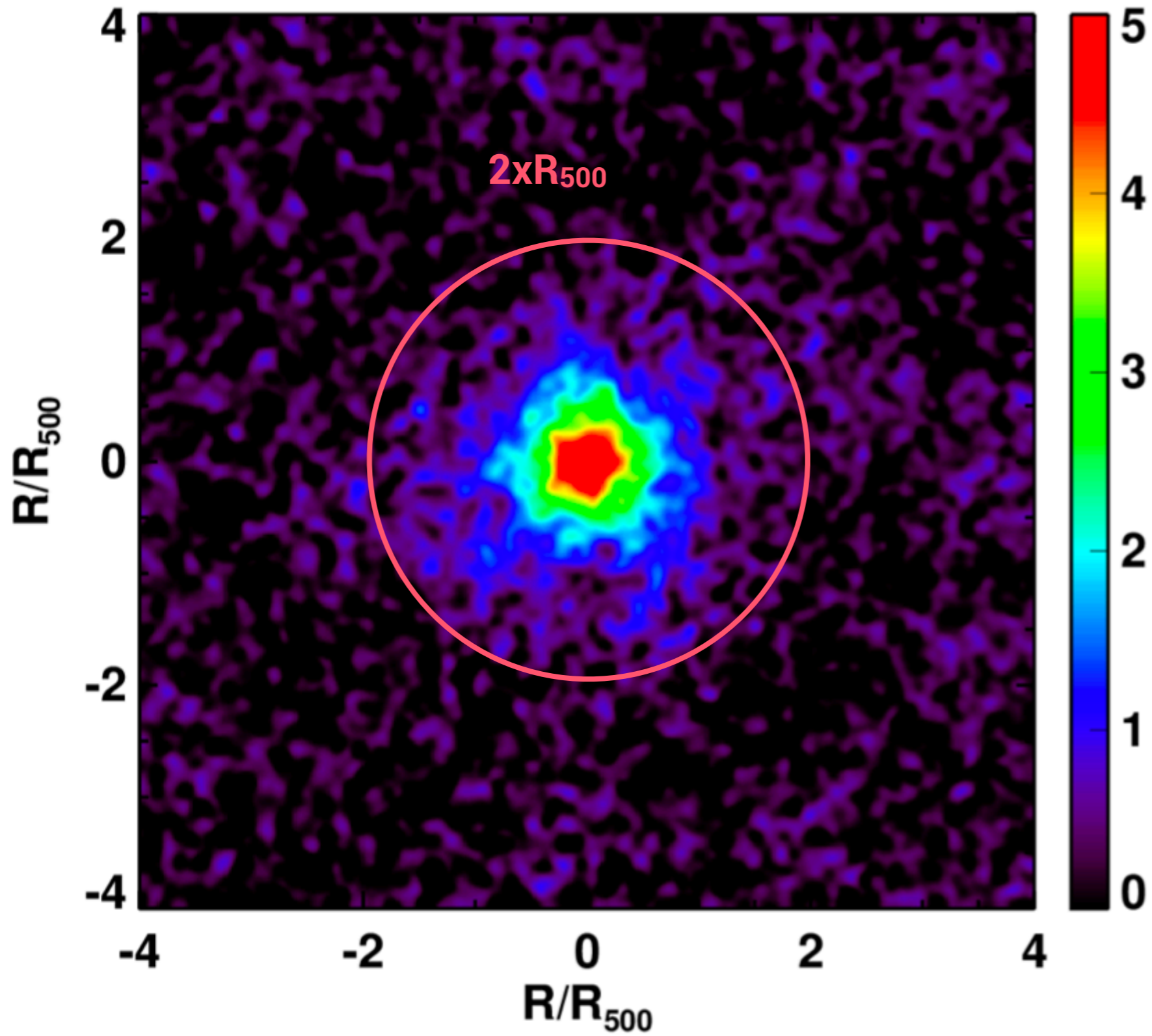
Method identical to Planck Collaboration Int. Results V. 2014

# Validation & cross-checks



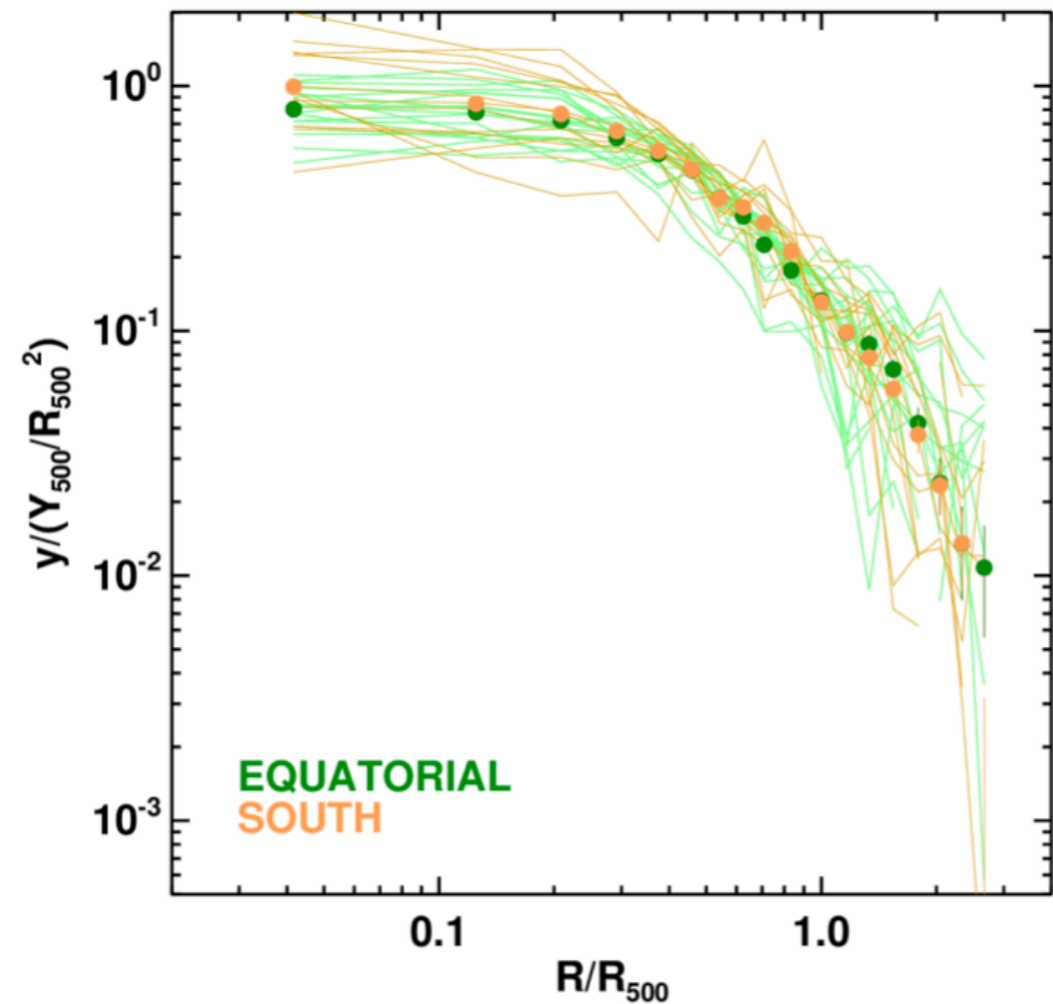
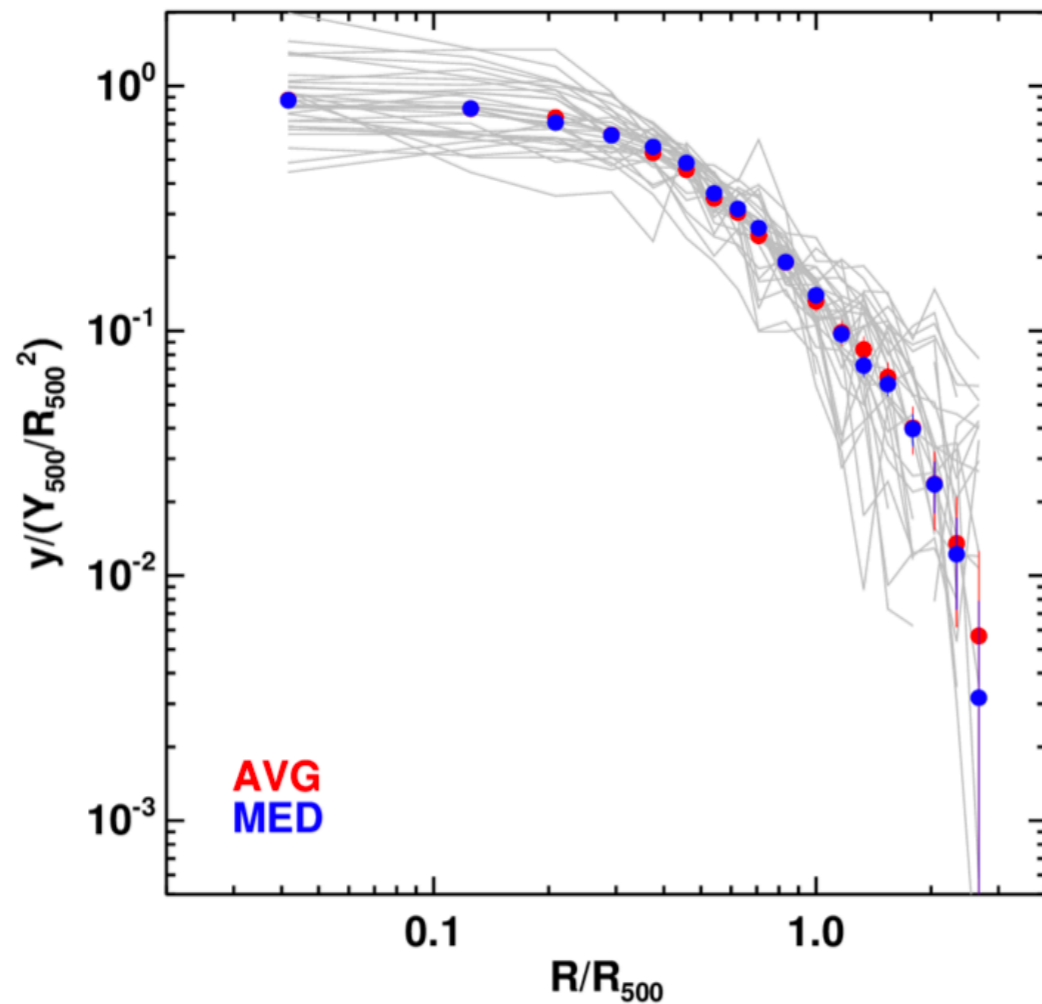
PACT31 (red dots) and PLCK62 (blue dots) samples

# Stacked y-map





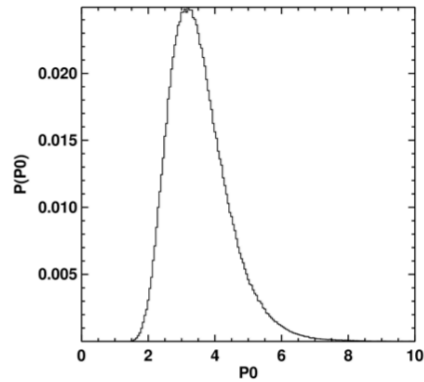
# Stacked y-profiles



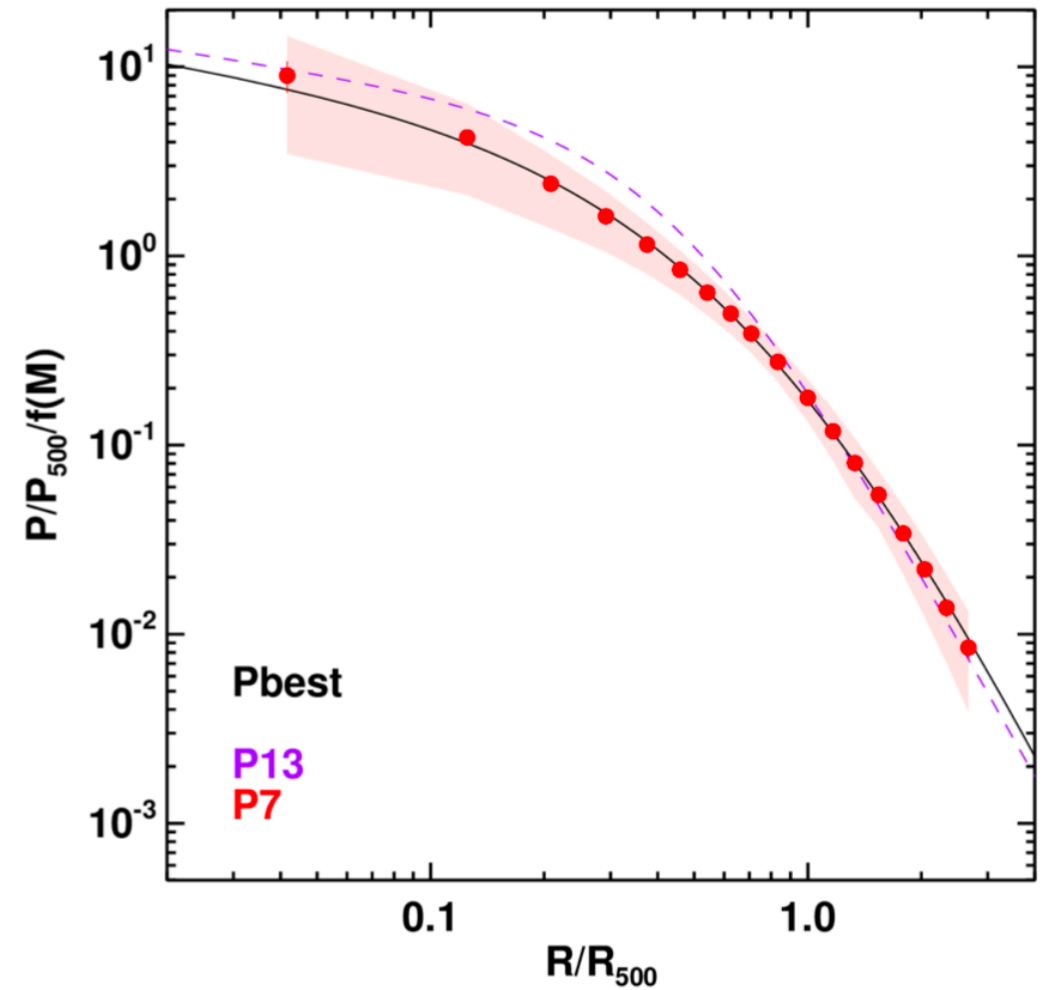
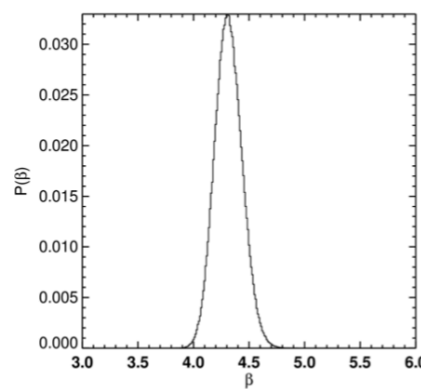
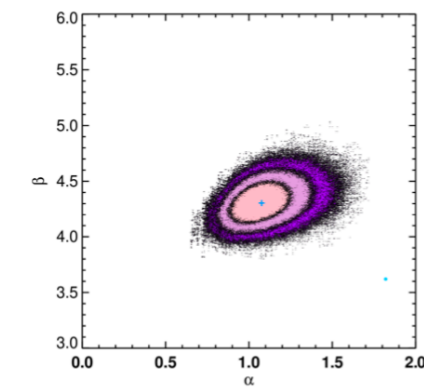
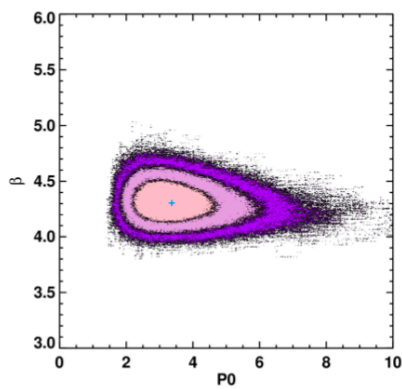
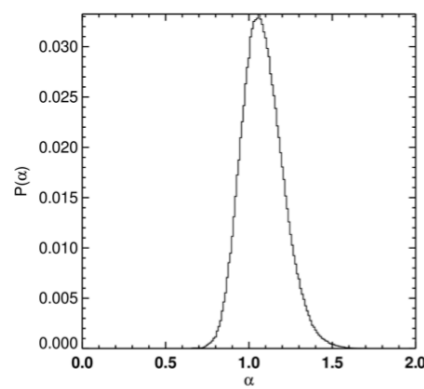
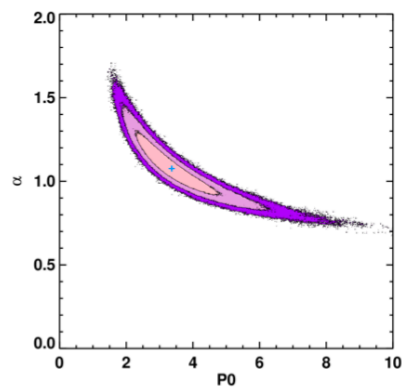
Average vs median y-profiles

Equatorial vs Southern y-profiles

# Pressure profile

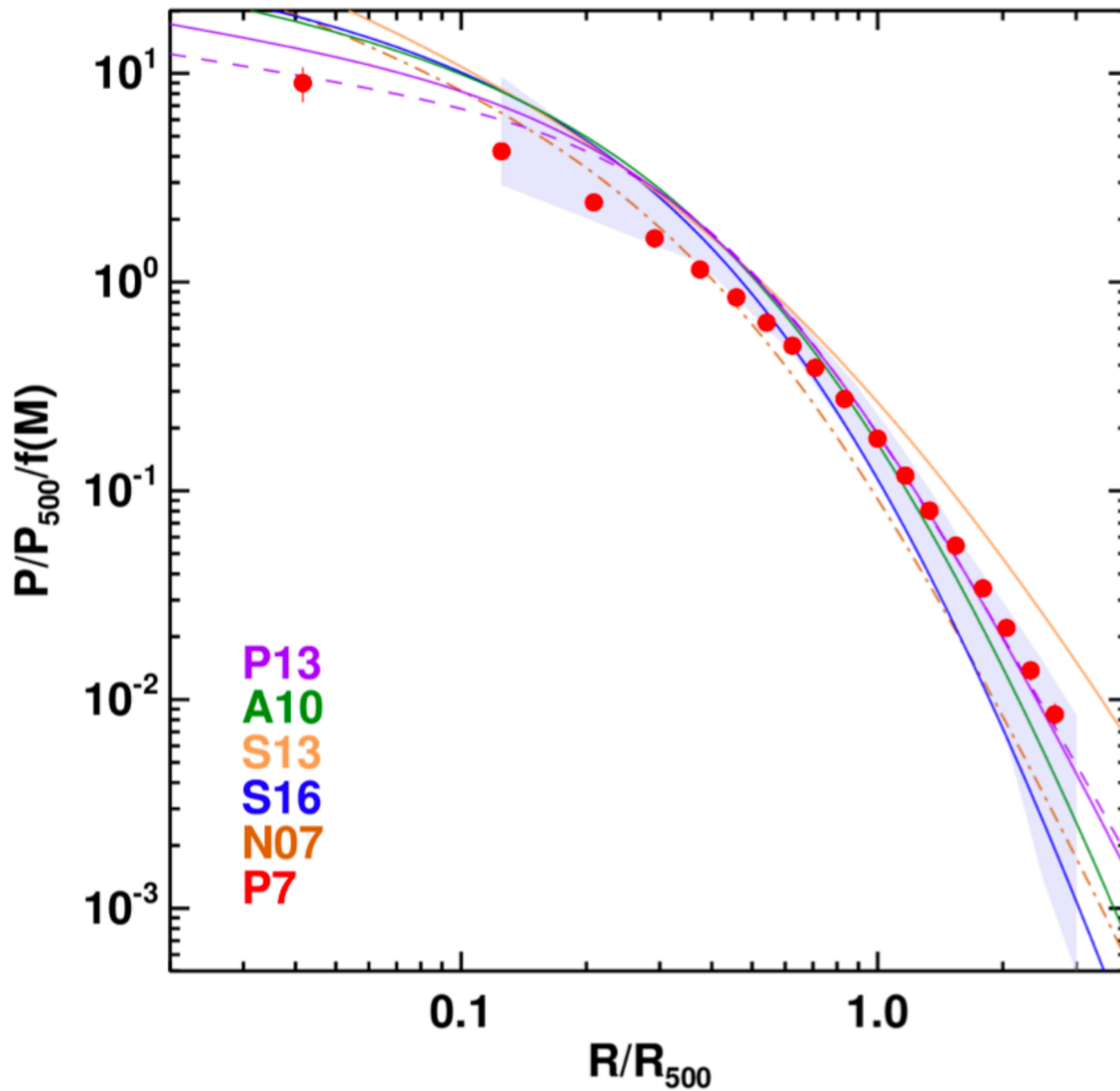


	$P_0$	$c_{500}$	$\alpha$	$\beta$	$\gamma$
<b>P7</b>	<b>3.36</b>	1.18	<b>1.08</b>	<b>4.30</b>	0.31
	+0.90	—	+0.13	+0.12	—
	-0.71	—	-0.11	-0.12	—



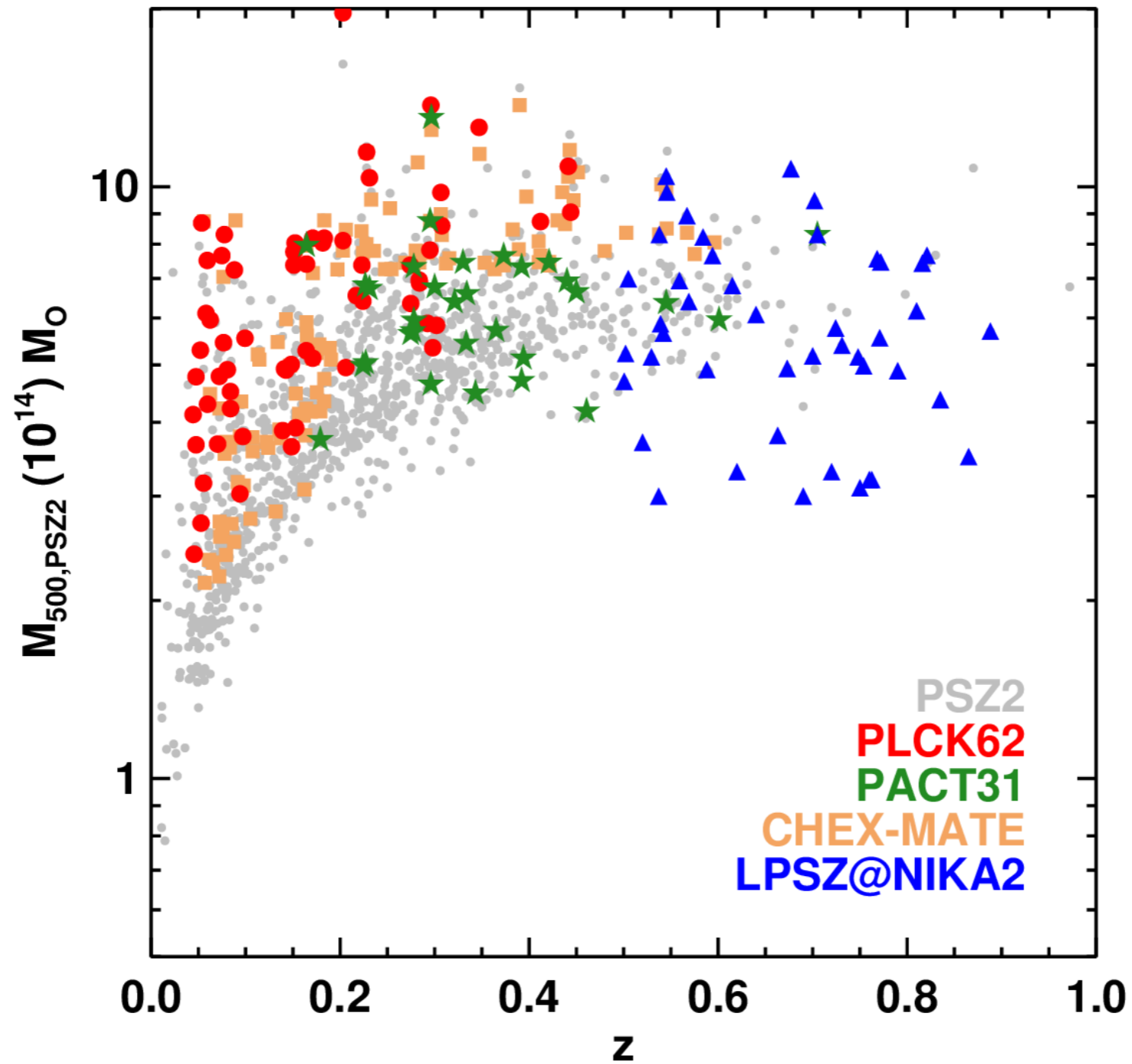
Best MCMC fit of a gNFW profiles

# Pressure profile



PACT pressure profile

# About samples



SZ selected samples

# CONCLUSIONS



Self consistent SZ analysis combining Planck and ACT data

—> Planck large scale modes + ACT resolution

SZ standalone description of the ICM pressure distribution

—> Radial range [0.04,2.5]  $R_{500}$

—> Competitive with joint X-ray and SZ analysis

Perspectives for other studies

—> CHEX-MATE

—> NIKA-2 SZ large program sample



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PACT I : Aghanim et al. 2019 <https://arxiv.org/abs/1902.00350>

PACT II : Pointecouteau al. 2021 <https://arxiv.org/abs/2105.05607>