KAT-7 observations of an unbiased sample of mass-selected galaxy clusters

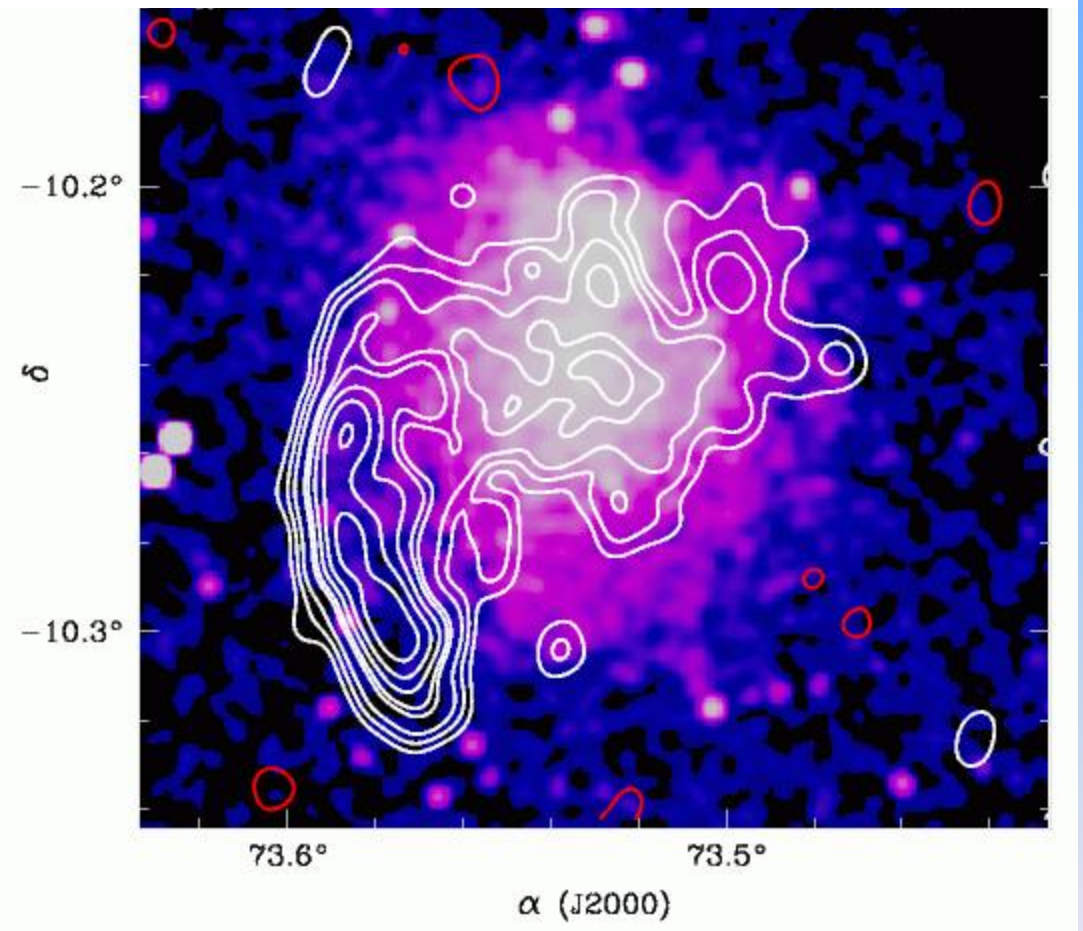
Gianni Bernardi
(SKA SA & Rhodes University)
+
T. Venturi, R. Cassano, G. Brunetti, D. Dallacasa, V. Cuciti
(ORA-INAF, DiFA)
+
N. Oozeer, O. Smirnov
(SKA SA)

"The Many Facets of Extragalactic Radio Surveys: towards new scientific challenges", Bologna, October 20-23, 2015

Setting the scene

(see Cassano's talk + all my predecessors in this section ☺)

A521

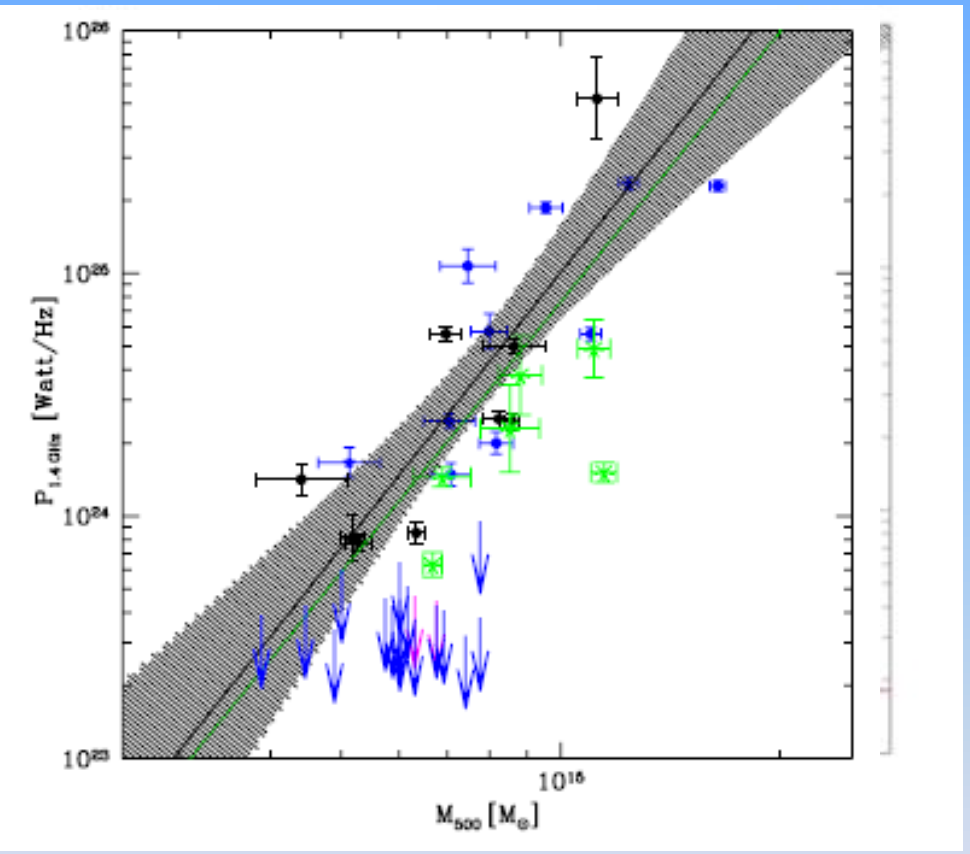


Brunetti et al. (2008)

The current winner is:

- diffuse emission is generated by turbulent reacceleration of relativistic electrons in the ICM (i.e. Brunetti & Jones 2014);
- strong link with the cluster merging history (i.e. Cassano & Brunetti 2005)

Cluster statistics is a stringent test of radio halo models



Cassano et al. (2013)

Bimodal distribution of luminous X-ray clusters ($L_{500} > 5 \cdot 10^{44}$ erg s^{-1}):

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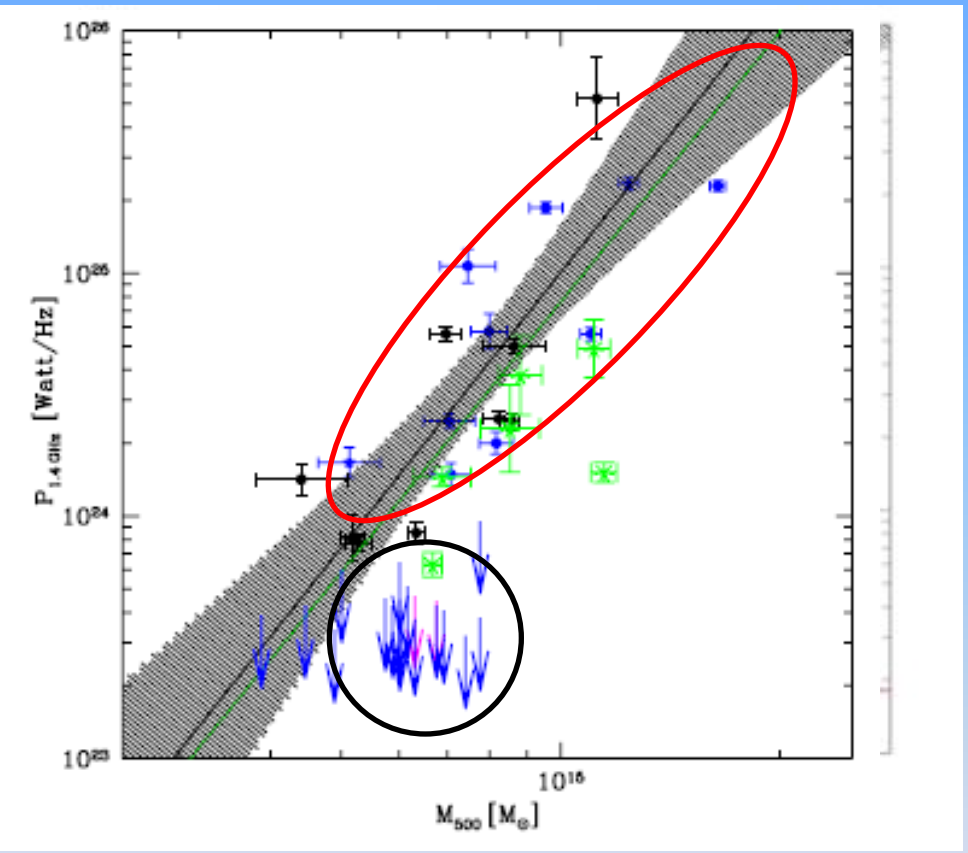

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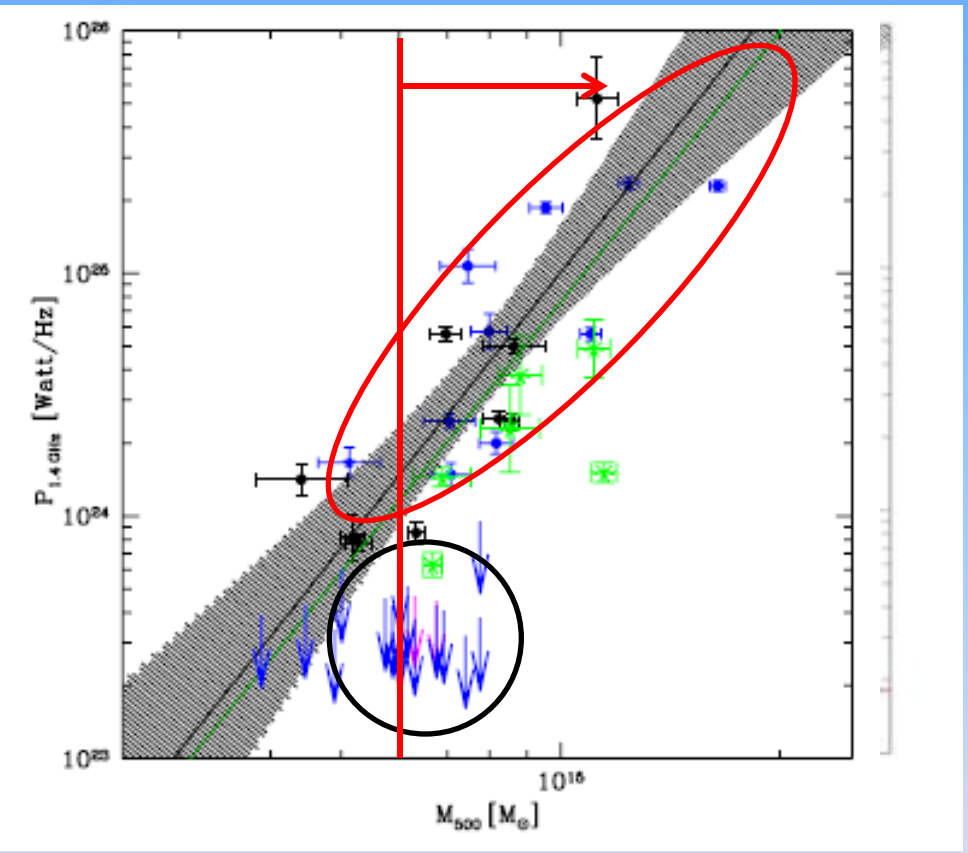

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The Cassano sample

All the clusters from the Planck SZ Cluster Catalogue (Planck Collaboration 2015) with:

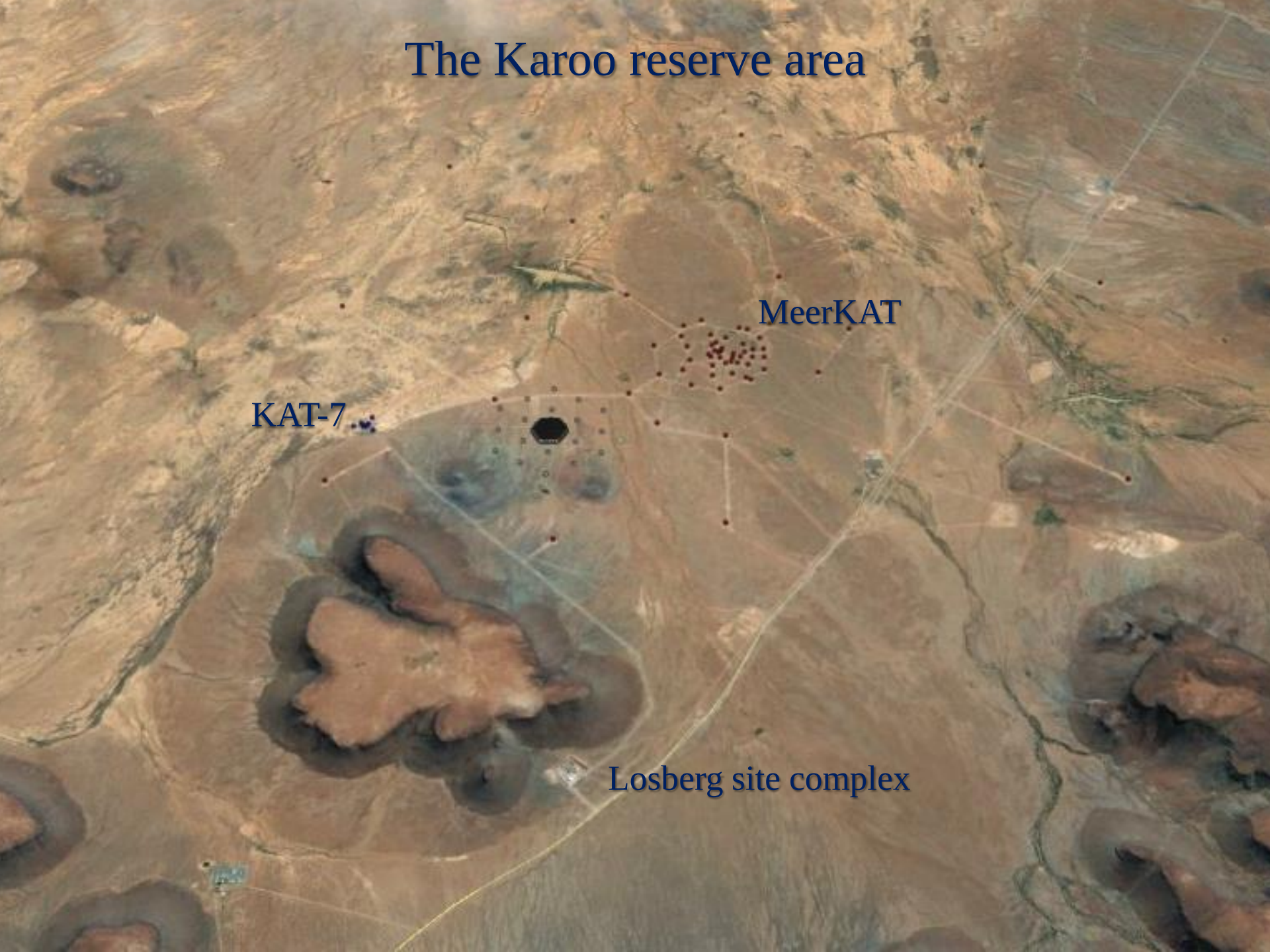
- $M_{500} > 4 \cdot 10^{14}\ M_{\odot}$;
- $0.05 < z < 0.11$;
- $\delta < 0°$

Observations with the 7-element Karoo Array Telescope (KAT-7):

- 14 clusters at 1.86 GHz (256 MHz instantaneous bandwidth);
- 5 – 7 h observations for each target (88 h in total) to achieve good and uniform uv-coverage;
- 0.3 – 0.7 mJy beam^{-1} noise rms across the sample;
- includes a 1.33 GHz archive observation of the Triangulum Australis (Scaife et al. 2015);

KAT-7 in the world map

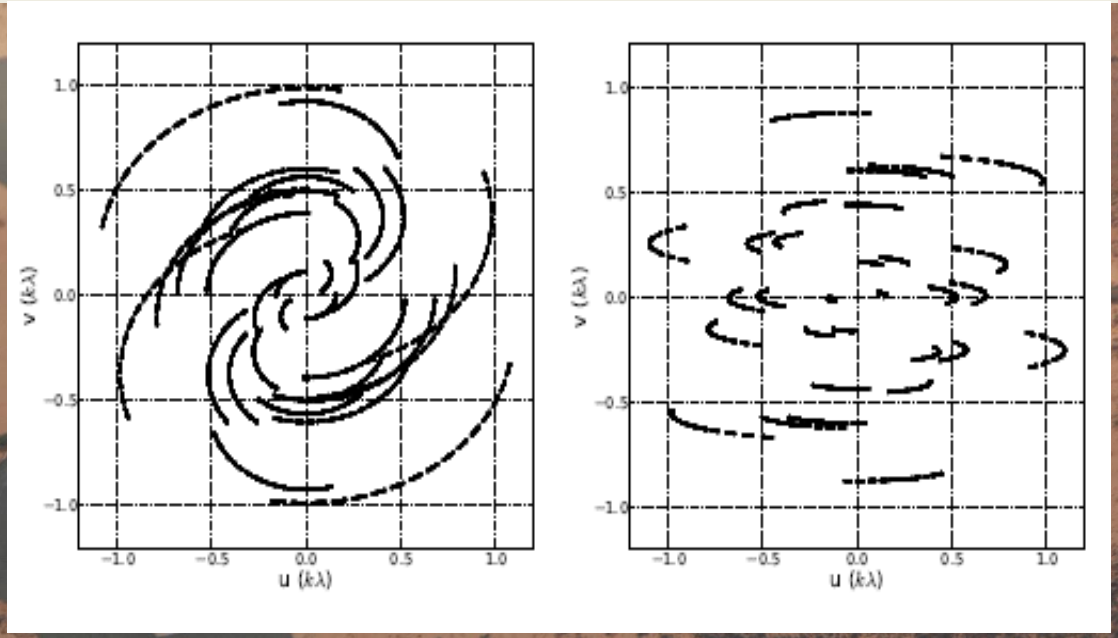
The Karoo reserve area



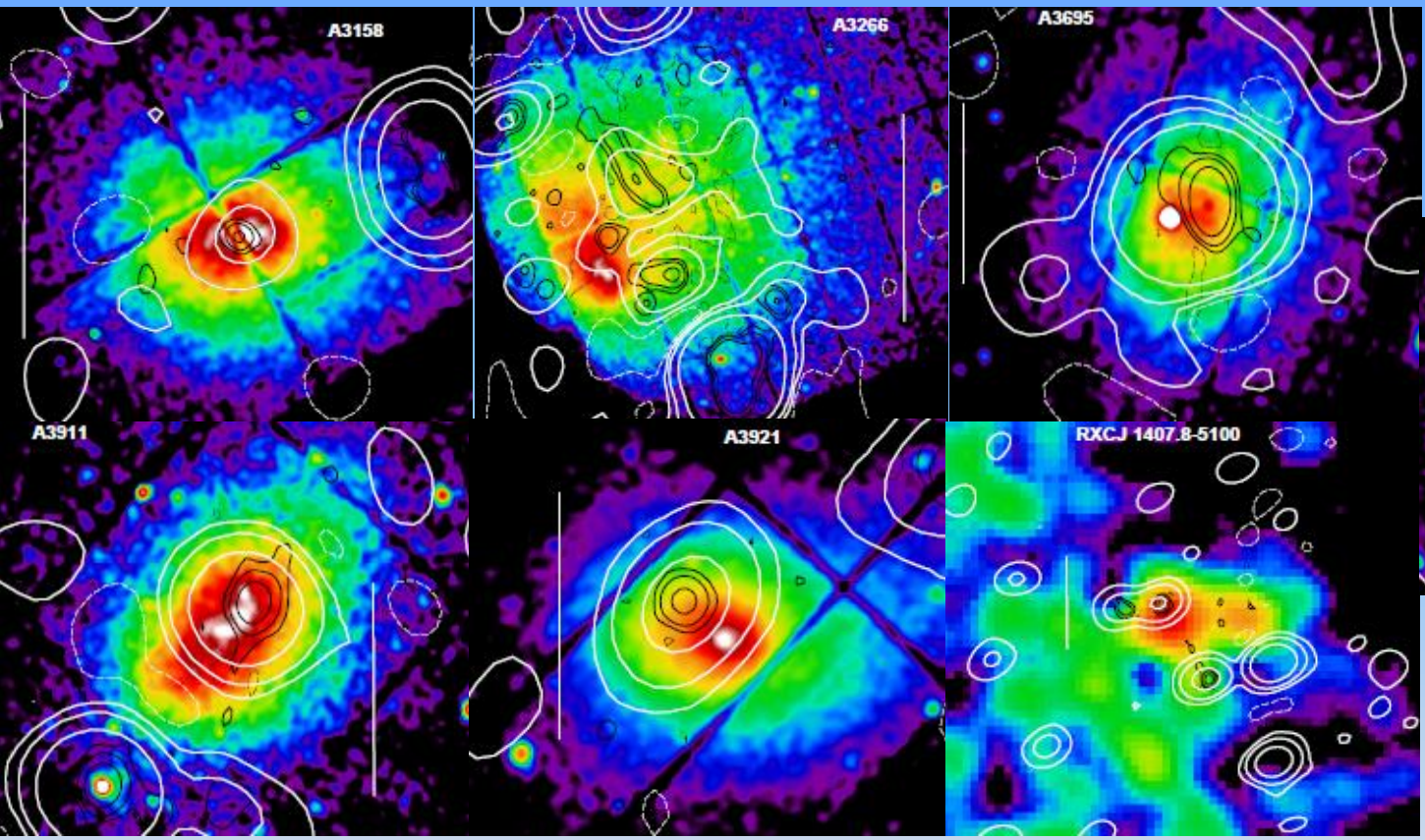
KAT-7: aerial view

KAT-7: aerial view

- seven 12 m antennas in a configuration that optimizes the uv coverage in ~ 4 h;
- compact configuration (12 – 185 m baselines) for good brightness sensitivity;
- frequency coverage: 1200 – 1950 MHz (with a 256 MHz instantaneous bandwidth);

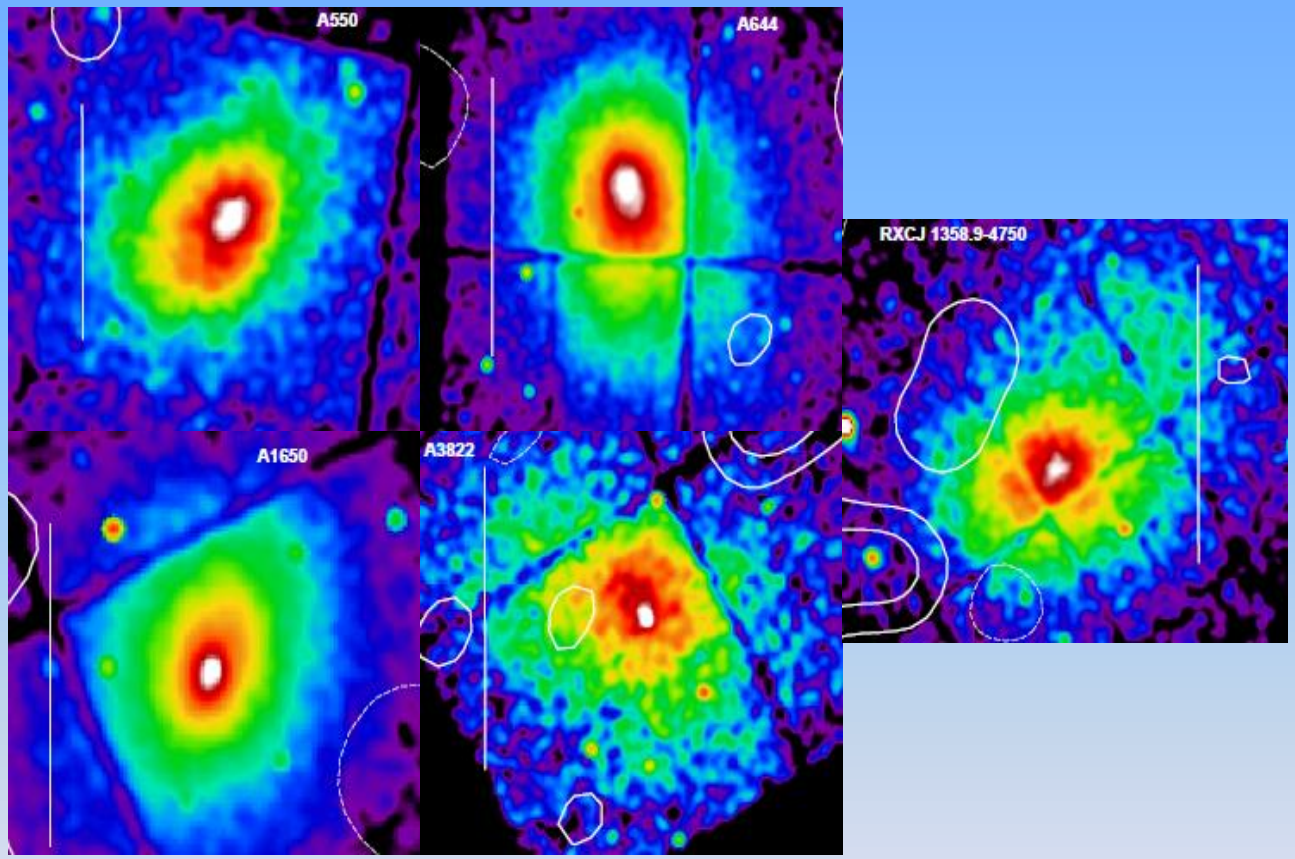


Results: 1) detections (not radio halos though)

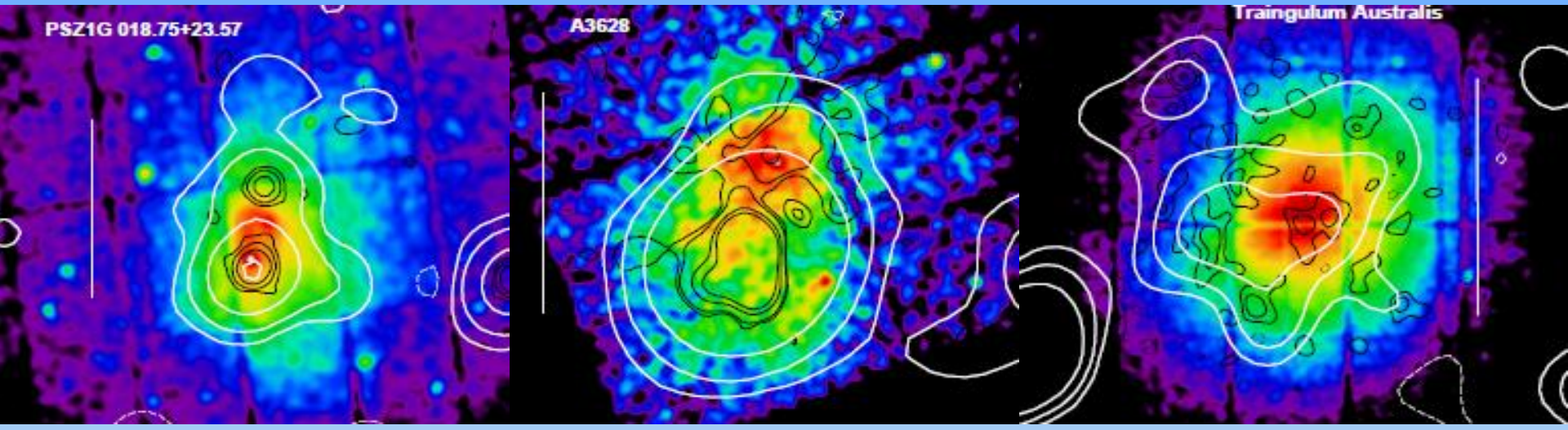


- images from Chandra a/o XMM-Newton;
- white contours from KAT-7;
- black contours from NVSS a/o SUMSS;

Results: 2) no detections



Results: 3) candidate diffuse-scale emission



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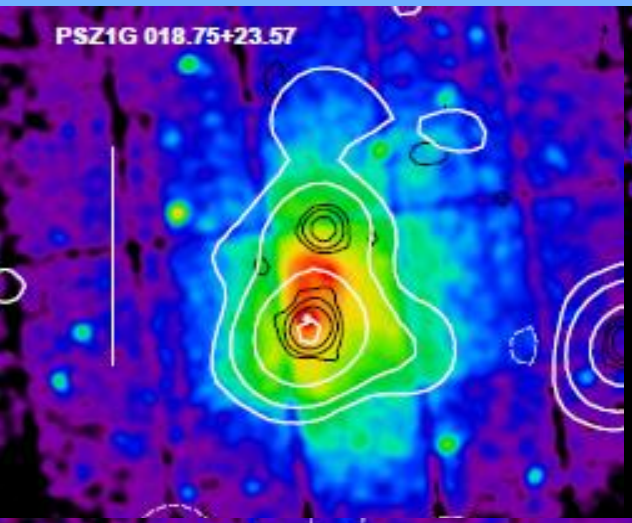

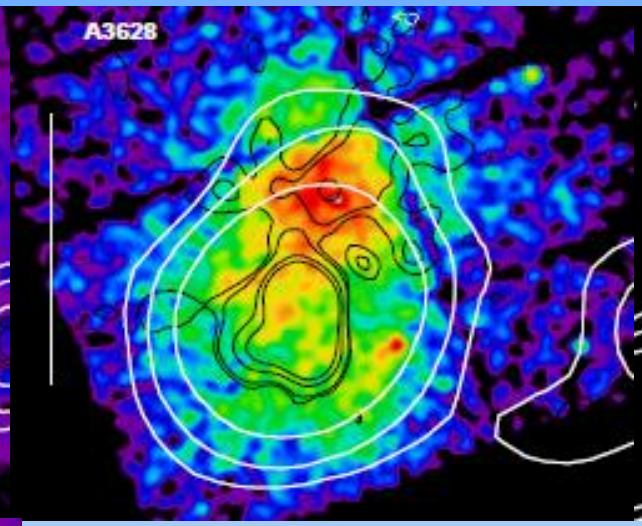

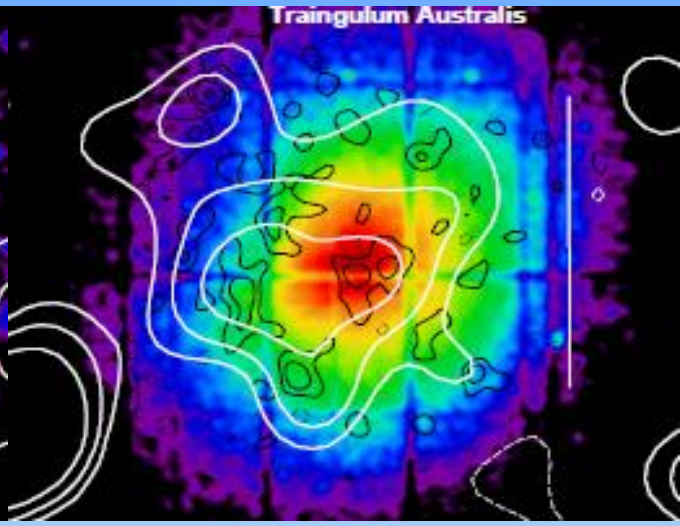

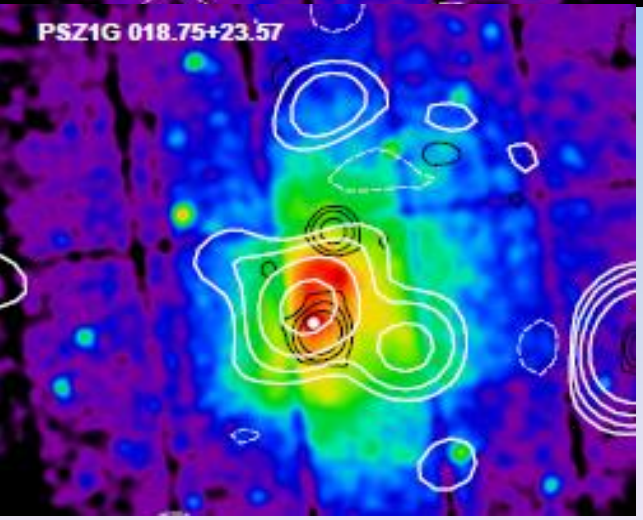

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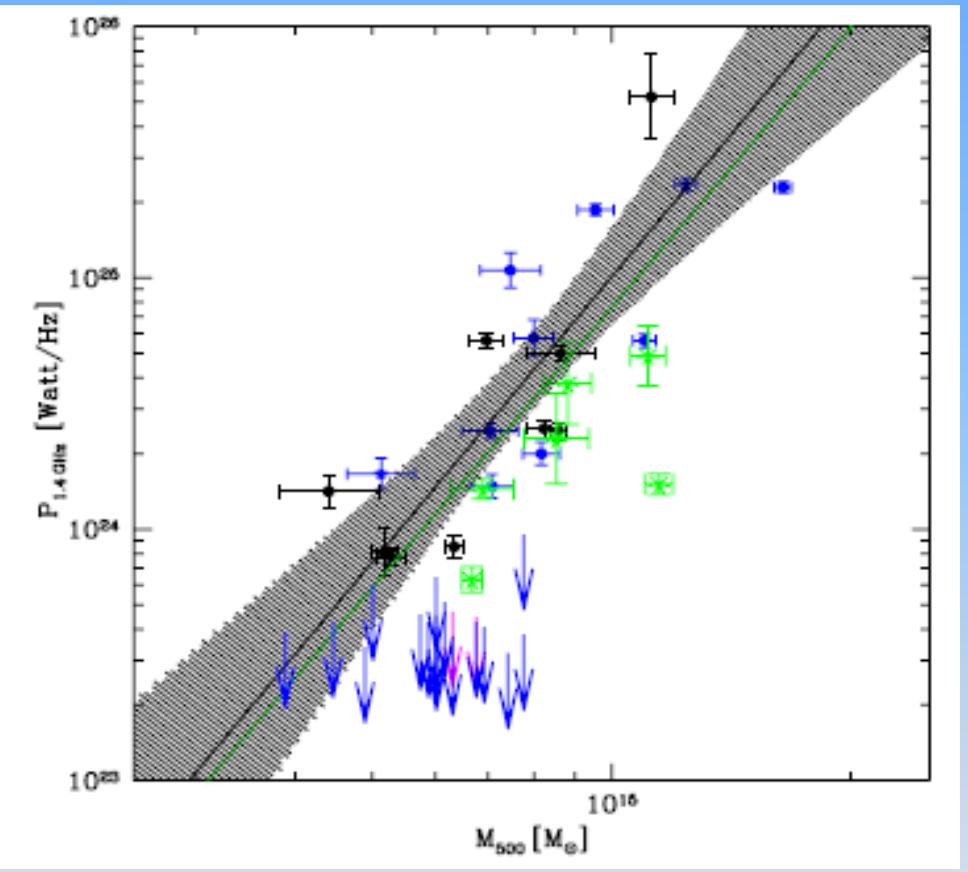
KAT-7 results in the big picture



Cassano et al. (2013, see also Basu et al. 2012, Yuan et al. 2015)

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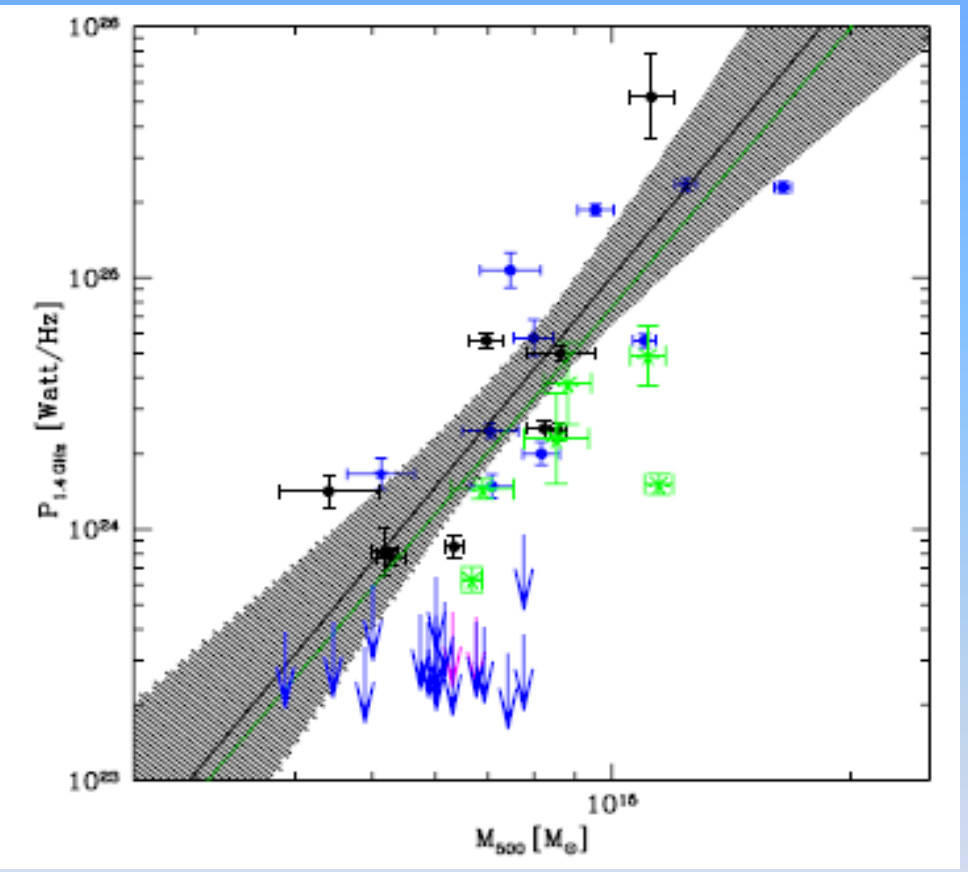

+ 7 clusters with upper limits to diffuse emission
+ residual diffuse emission in PSZ1G018
+ diffuse emission from the Triangulum Australis cluster

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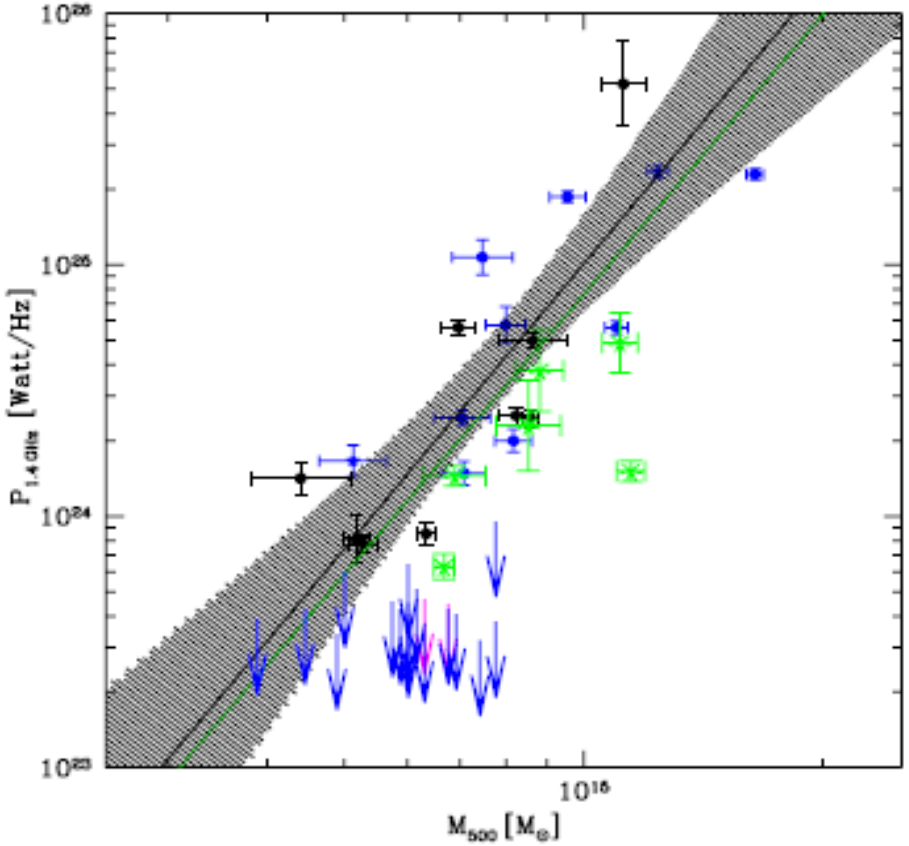

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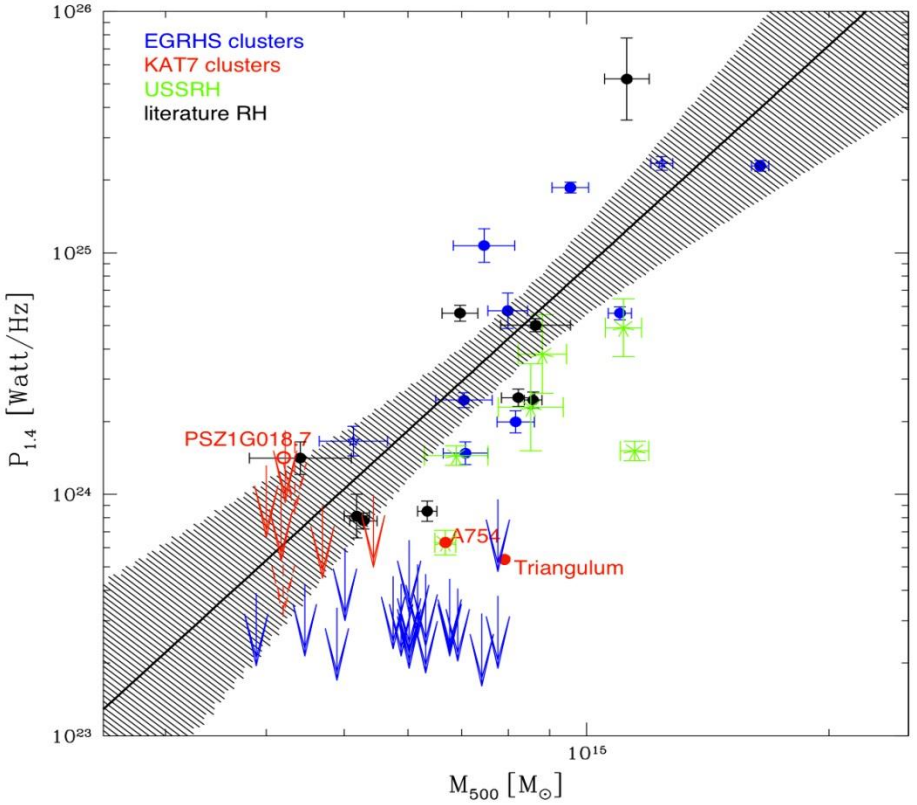

GB et al., 2015, MNRAS, in press

Conclusions and future outlook

- upper limits on radio diffuse emission for 7 clusters ($M_{500} > 4 \cdot 10^{14}\ M_{\odot}$; $0.05 < z < 0.11$) at the level of $P_{1.4} = 0.6 – 1.9 \cdot 10^{24}$ Watt Hz^{-1} (within the 2σ errors on the correlation best-fit slope);
- two candidate radio halos in PSZ1G018 and Triangulum Australis (Scaife et al. 2015) clusters;
- bright radio halos are statistically rare in less massive systems;
- the $P_{1.4}$ - M_{500} relation has a steep slope (if it holds down to less massive systems);

a) what is the fraction of radio halos in small systems?

b) is there a bimodal distribution a low masses?

c) what is the slope of the $P_{1.4}$ - M_{500} correlation (improved constraints)?

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THANK YOU

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