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

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Setting the scene
(see Cassano’s talk + all my predecessors in this section 😊)

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)

Brunetti et al. (2008)
Cluster statistics is a stringent test of radio halo models

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Cassano et al. (2013)
All the clusters from the Planck SZ Cluster Catalogue (Planck Collaboration 2015) with:

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

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

MeerKAT

KAT-7

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

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KAT-7 results in the big picture

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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 2$\sigma$ 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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