An update from the Arcminute Microkelvin Imager
New results and ongoing SZ science

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The Arcminute Microkelvin Imager


The Large Array:
“Source subtractor”

The Small Array: “SZ/Science Array”
Generalised Noise Model

- Three noise components:
  - Johnson receiver noise (Gaussian),
  - Primordial CMB – know power spectrum
  - Radio point sources – know positions and fluxes
- Use above information in Bayesian fashion
Modelling the cluster – 1. Physical parameters

Sample parameter space to get posterior probability distributions

\[ \Theta_c \equiv (x_c, y_c, r_c, \beta, f_g(r_{200}), M_T(r_{200}), z) \]

\[ k_B T_g(r_{200}) = 8.2 \left( \frac{M_T(r_{200})}{10^{15} h^{-1} M_\odot} \right)^{2/3} \left( \frac{H(z)}{H_0} \right)^{2/3} \text{ keV} \]
The Generalised NFW (GNFW) pressure model

\[ P_e(r) = \frac{P_{ei}}{\left( \frac{r}{r_p} \right)^c \left[ 1 + \left( \frac{r}{r_p} \right)^{a} \right]^{(b-c)/a}} \]

(Nagai et al. 2007)

\( (a, b, c, c_{500}) = (1.0620, 5.4807, 0.3292, 1.156) \)

(Arnaud et al. 2010)

\[ \rho_{DM}(r) = \frac{\rho_s}{\left( \frac{r}{R_s} \right)^{2} \left( 1 + \frac{r}{R_s} \right)} \]

(Navarro et al. 1997)
SZ study with AMI of 20 LoCuSS galaxy clusters
The LoCuSS sample – Mass Comparaison

- 20 clusters with \((0.142 \leq z \leq 0.295)\) so no cosmic evolution
- \(L_{\text{ROSAT}} > 7 \times 10^{37}\) W, no bright radio sources
- AMI gets to \(r_{200}\)
- AMI \(M_{\text{Total 200}}\) and \(M_{\text{Total 500}}\) in good agreement with optical lensing masses
- AMI \(M_{\text{Total 500}}\) lower than X-ray masses
**$T_{SZ} \text{ vs } T_X$**

- AMI temperature is from $SZ \ 'alone'$
- Comparing with $T_X$ at large radius ($\approx 300$-$700$ kpc) from Chandra and ($\approx 700$-$1200$ kpc) for A1413 from Suzaku
- Result: Some correlation, some outliers, outliers are major mergers
Comparison of SZ measurements from *Planck* and AMI for 11 clusters
Selection Criteria

• Originally 26 clusters (24 known, 2 unknown)
• Only retained firm detections from AMI
  • > 3 \( \sigma \) before source subtraction
  • > 5 \( \sigma \) after source subtraction
• Keep 11 detections with begin source environment
Results:

\[ Y_{500} \text{ (arcmin}^2) \]

Planck constraints

AMI constraints

Joint constraints

Michel Schammel
Rencontres de Moriond 2012
Results:

\[ Y_{500} \text{ (arcmin}^2 \text{)} \]

Joint constraints

AMI constraints

Planck constraints

\[ \theta_{500} \text{ (arcmin)} \]
The scientific results that were presented here are the product of a joint venture between the Planck Collaboration and the AMI Consortium, including individuals from more than 50 scientific institutes in Europe, the USA, Canada and Australia.
AMI blind survey: An update
Blind Survey: Fields selected and observed

- 12 patches of $\approx 1 \text{ deg}^2$, completely different from ACT and SPT
- Very deep integration: Typical noise levels $\approx 100 \, \mu\text{Jy}$
- Aim is to find low-mass clusters: $> 2 \times 10^{14} \, h^{-1} M_{\text{sun}}$
Blind Survey: A first blind detection

AMI Consortium: Shimwell et al. 2010, arXiv1012.4441S

Before source subtraction:

After source subtraction:

Cont peak flux = 2.6811E-03 JY/BEAM
Levs = 6.650E-03 (-10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10)
## Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Lower component</th>
<th>Upper component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass ( \times 10^{14} h^{-1}<em>7 M</em>\odot )</td>
<td>( 5.5^{+1.2}_{-1.3} )</td>
<td>( 3.5^{+0.9}_{-0.9} )</td>
</tr>
<tr>
<td>Temperature decrement (μK)</td>
<td>( -295^{+36}_{-15} )</td>
<td>( -302^{+70}_{-27} )</td>
</tr>
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</table>
Blind Survey: Status

- Data from 10 fields are now analysed, result coming soon…
- Using different parameterisations to model clusters
- Reevaluating the AMI selection function for the latest data reduction
Recent publications


AMI Consortium: Shimwell et al. 2011, arXiv1101.5590S

AMI Consortium: Shimwell et al. 2010, arXiv1012.4441S