

On behalf of the APEX-SZ collaboration

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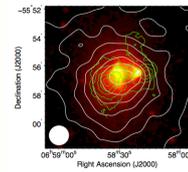
**Abstract:** The APEX-SZ experiment is a collaboration between Berkeley, University of Bonn, MPIfR, University of Chicago, Onsala, Cardiff, MPE and ESO operating a 280 element bolometer camera at the APEX telescope in Chile at an altitude of 5100 meters during 2007-2010. Targeted observations of over 40 X-ray selected galaxy clusters were made. The APEX-SZ group in Bonn has focused its research on non-parametric cluster modeling with APEX-SZ data and its combination with X-ray and weak-lensing results. A joint SZ/X-ray analysis has already been made for individual clusters and is currently being extended to the full APEX-SZ sample. Weak-lensing analyses of all APEX-SZ clusters is also under way following a successful imaging campaign with the ESO Wide Field Imager camera. We are also developing and optimizing techniques for combining high resolution interferometric measurements with APEX-SZ data to extract information on the thermodynamic state of the intra-cluster gas at a wide range of spatial scales.



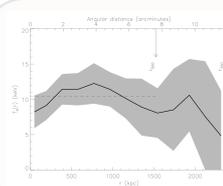
The 12 m APEX telescope (left) located at 5107m altitude on the Llano de Chajnantor plateau and the APEX-SZ TES bolometer array consisting of 330 bolometers (right). (Schwan et al. 2010)

### Characteristics:

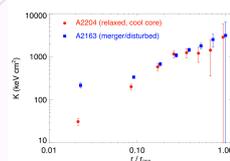
primary mirror	12 m
band center	151 GHz
field of view	22'
beam FWHM	58"
bandwidth	24.5 GHz
surface accuracy	17-18 $\mu\text{m}$
NET <sub>CMB</sub>	860 $\mu\text{K}_{\text{CMB}}$ $\sqrt{\text{s}}$
efficiency	0.31
bolometers	280



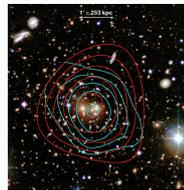
APEX-SZ observation of the Bullet cluster (white contours) overlaid on an XMM-Newton map and green weak lensing contours (Clowe et al. 2006), the SZE interval being 100  $\mu\text{K}_{\text{CMB}}$ . (Halverson et al. 2009)



De-projected temperature profile of Abell 2163 from X-ray (XMM-Newton) and APEX-SZ data with 1 $\sigma$  uncertainties. This was the first non-parametric de-projection of density and temperature beyond R<sub>500</sub>. (M. Nord et al. 2009)

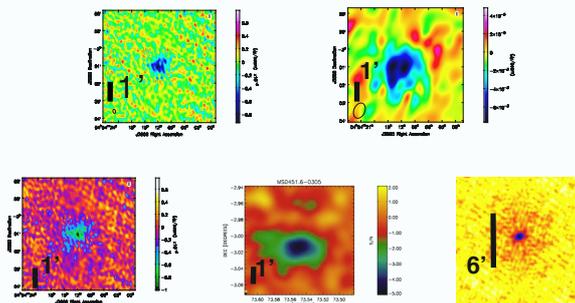
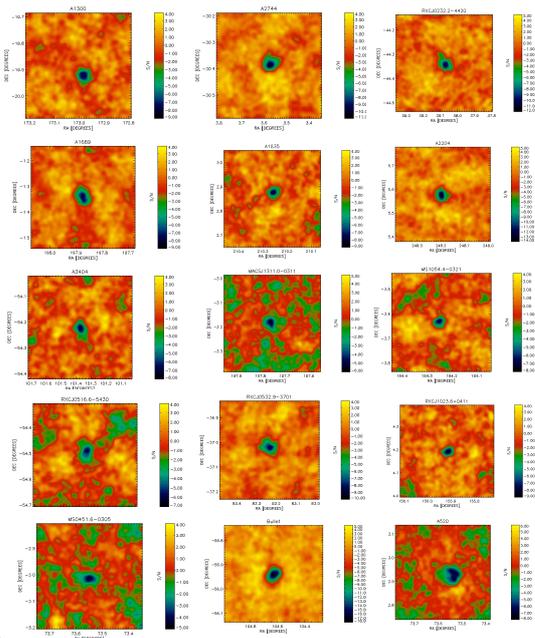


Entropy derived from APEX-SZ and X-ray data for the relaxed cluster Abell 2204 (red circles) and the merging cluster Abell 2163 (blue squares). (K.Basu et al. 2010)



B, V, R color image of the central region of RXCJ0232.2-4420 ( $z = 0.28$ ) with SZE contours in cyan (-90, -110, -130, -150, -170  $\mu\text{K}_{\text{CMB}}$ ) and smoothed weak lensing convergence contours in red (0.10, 0.11, 0.12, 0.13, 0.14). (M. Klein et al. 2012 in preparation)

Targeted observations of over 40 X-ray selected clusters were done with APEX-SZ until the end of 2010, a selection of which is shown below:



**Top Left:** Simulated 90 GHz CARMA E-array data of MS0451. **Top right:** Simulated 90 GHz SZA data. **Bottom Left:** Combined feathered SZA+CARMA image. **Bottom Middle:** Deconvolved APEX-SZ map. **Bottom right:** Smoothed combination of the CARMA feathered image with APEX-SZ data.

This is a study to combine single dish APEX-SZ data with interferometric measurements to re-construct the intra-cluster pressure profile at a wide range of spatial scales (S. Burkutean et al. 2012 in preparation). A combination of APEX-SZ, X-ray, weak and strong lensing data will also enable the modeling of the triaxiality of galaxy clusters.

D. Schwan et al. 2011, Review of Scientific Instruments, Volume 82, Issue 9, N.W. Halverson et al. 2009, ApJ, 701, 42, Nord et al. 2009, A&A, 506, 623, K. Basu et al. 2010, A&A, 519, A29, Clowe et al. 2006, ApJ, 648, 109, A. Bender et al. 2012 in preparation, M.Klein et al. 2012 in preparation, S. Burkutean et al. 2012 in preparation