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APEX Sunyaev-Zeldovich observations of the merging galaxy cluster Abell 2744

C. Horellou[1], D. Johansson[1], A. Koloczek[1], R. Singh[1], and the APEX-SZ collaboration[2]

[1] Onsala Space Observatory, Department of Earth and Space Sciences, Chalmers University of Technology, SE-439 92 Onsala, Sweden
e-mail: Cathy.Horellou@chalmers.se
[2] The APEX-SZ collaboration consists of researchers at the University of California, Berkeley, and the University of Colarado (USA), Mc Gill University (Canada), Bonn University, the Max-Planck Institute for Radio Astronomy, and the Max-Planck Institute for Extraterrestrial Physics (Germany), ESO, Onsala Space Observatory (Sweden).

Abstract. This work is part of a Large Programme with APEX to map the SZ decrement at a wavelength of 2 mm in about 50 galaxy clusters. Both isolated and merging clusters were observed, and part of the XMM-LSS field. The sample will be used to constrain mass–SZ-observable scaling relations, and some individual clusters are studied in detail. Here we present SZ maps at 2 mm and at 870 μm of Abell 2744, a massive galaxy cluster at redshift 0.31 that shows evidence of merging activity. We used two bolometer cameras on APEX: ASZCA (also called APEX-SZ), and LABOCA. With careful treatment of the data it is possible to quantify the size of the hot plasma distribution, to measure the Compton parameter ($y \propto n_e T_e dl$), and to detect deviations from the X-ray brightness distribution.

Key words. Galaxies, individual: Abell 2744 – Galaxies: clusters: individual: Abell 2744 – Cosmology: observations

1. Introduction

Sunyaev-Zeldovich (SZ) observations are quickly maturing into a valuable tool to probe hot gas in galaxy clusters, providing a useful complement to X-ray observations. Between 2007 and 2010, the APEX telescope, a 12-m antenna located in the Chilean Andes near the ALMA site, was used in an extensive observing program to map the SZ decrement at 2 mm (150 GHz) in galaxy clusters. Observations were performed during about three weeks per year, in a combination of Swedish and German observing time using the 330-element bolometer camera built at the University of California, Berkeley. The instrument was described by Schwan et al. (2010). Published results include detailed studies of the Bullet Cluster, Abell 2163 and Abell 2204 (Halverson et al. 2009, Nord et al. 2009, Basu et al. 2010) and of the power spectrum of millimiter wave anisotropies at 150 GHz (Reichardt et al. 2009). Several papers are in preparation, including a study of

Send offprint requests to: C. Horellou

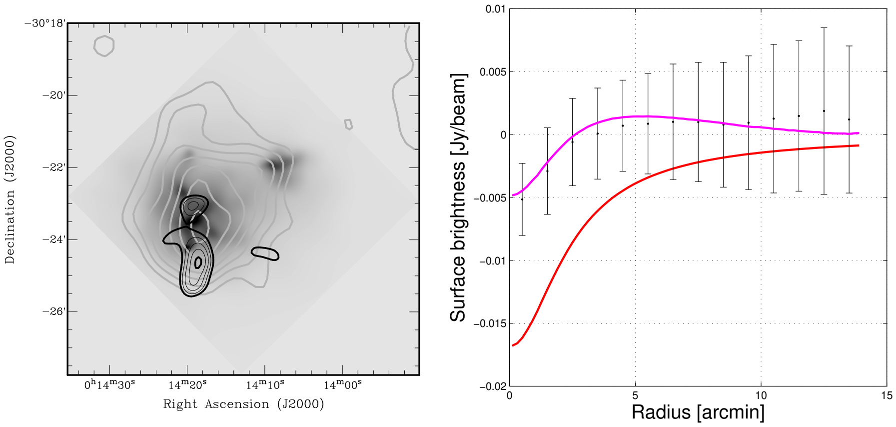

Fig. 1. *Left:* The grey-scaled image shows the X-ray surface brightness (Chandra map from Kempner & David 2004); the grey contours show the significance of the detection of the SZ decrement at 2 mm (ranging from a signal-to-noise ratio of −10 to −4 in steps of +1; the map was smoothed to an angular resolution of 85″); the black contours show the signal-to-noise of the 870 μm map, ranging from +4 to +6 in steps of 0.5. The map was smoothed to a resolution of 45″. *Right:* Radial profile of the unsmoothed ASZCA 2 mm map. The data were binned in 1′ bins; the curve starting at about −17 mJy/beam corresponds to the best-fit beta-model, that, convolved with the transfer function, produces the curve above.

mass–SZ observable scaling relations (Bender et al. in prep).

2. SZ in Abell 2744

There is ample observational evidence that Abell 2744 is undergoing a major merger (e.g. Govoni et al. 2001, Girardi & Mezzetti 2001, Kempner & David 2004, Cypriano et al. 2004, Boschin et al. 2006, Orrú et al. 2007, Owers et al. 2010). Previous SZ observations of Abell 2744 include marginal detections at 1.2 and 2 mm by Andreani et al. (1996) using SEST, and South Pole Telescope observations at 1.4 and 2 mm by Plagge et al. (2010).

Because the noise is not completely uniform across the field, the map of the SZ surface brightness differs slightly from the signal-to-noise map that is presented in Fig. 1, although the general appearance is similar. In particular, a north-south elongation is seen in the central region, and an elongation toward the subcluster to the west is seen. The LABOCA map at 870 μm shows two peaks; interestingly, the one to the south seems to coincide with a region of increased X-ray temperature seen by Owers et al. (2010). Analysis of new SZ data is in progress, including a comparison with the X-ray maps.

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