RevMexAA (Serie de Conferencias), **17**, 263–263 (2003)

SEARCHING FOR CLUSTERS WITH SUMSS

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Searches for statistical overdensities of radio sources in the NRAO VLA Sky Survey (NVSS) survey have led to the detection of high redshift clusters of galaxies (Cotter et al. 2002; Croft et al. 2001). We have carried out a similar search for overdensities using the Sydney University Molonglo Sky Survey (SUMSS). Radio observations at 20/13 cm have been made of these candidates at the Australia Telescope Compact Array (ATCA) revealing sources of diffuse cluster emission as well as groups of FR1 sources showing structures associated with clusters, indicating a cluster "hit-rate" of about 70%.

There is increasing evidence that we live in a $\Omega_\Lambda = 0.7$, $\Omega_{\rm M} = 0.3$ universe (de Bernardis et al. 2002). This means clusters of galaxies should be present at high redshift (at least $z \sim 1$). However, few examples of such clusters have been found to date (Blanton et al. 2000; Chapman et al. 1998; Fabian et al. 2001; Rosati et al. 1999; Stanford et al. 1997).

We have thus been motivated to find a new search technique for distant clusters. Our technique has similarities to traditional optical/near-IR techniques, in that it is based on searching for statistical overdensities of objects. However, it improves on these techniques in two crucial ways: it can be pursued over the huge sky areas needed to find the rarest, most massive systems (IR detector arrays are not yet large enough to do this); and the huge contrast/contamination problems inherent in optical/near IR surveys are largely circumvented.

Our new technique uses deep, wide-area radio surveys and looks for statistical overdensities in the radiosource counts. At sufficiently faint radio flux-density levels, there is a reasonable probability that a cluster of galaxies will contain several radio-loud AGN, and this probability increases with redshift due to the cosmic evolution of the radiosource population. Naturally, such clusters will only be a subset of the population at any redshift. However, the selection effects introduced are likely to be different from those introduced by other methods. In particular, under the plausible expectation that AGN activity in clusters is triggered by a merger event, our technique is well-chosen to be complementary to X-ray selection which favours relaxed systems.

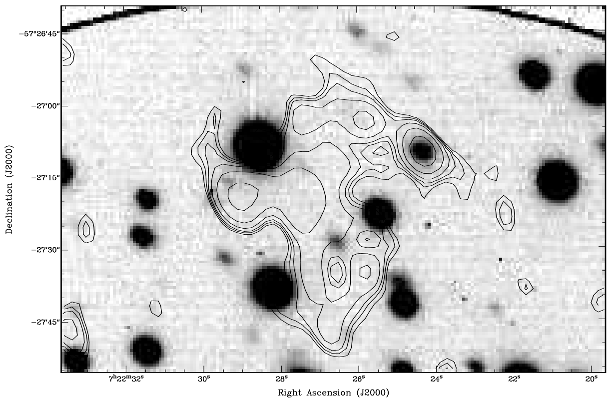

Fig. 1. A moderate redshift ($z \sim 0.5$) cluster found by our method. ATCA 1.4-GHz radio contours (0.4, 0.5, 0.6, 0.8, 1.2, 2.0, 3.6 and 6.8 mJy/beam) are overlaid on 2.3-m V-band images. The figure shows the weak diffuse radio "halo" emission associated with a cluster of galaxies.

This technique has been used on the NVSS where 70% of the overdensities have proven to be clusters of galaxies. We have now continued the search in the Southern hemisphere using the SUMSS which is closely matched in resolution, frequency and sensitivity to the NVSS. This search has resulted in 60 cluster candidates from the SUMSS.

We have followed up these clusters with radio observations at the ATCA. About 50% of the candidates have FR1 sources that show the structures (eg. WATs or bent trails) associated with clusters. As well as identifying individual radiosources, about 30% of our cluster candidates show some extended emission (see Fig. 1). *VRI* observations of 24 of the clusters also have been made at the 2.3-m telescope at Siding Spring Observatory.

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