FAINT RADIO SOURCES AND THE COSMIC MICROWAVE BACKGROUND

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1. Introduction & Observations

We have mapped a single field with the VLA to an unprecedented rms sensitivity of 1.5 μJy. Our observations reveal that the excess μJy population (see Windhorst et al (1993), Fomalont et al. (1993)) is continuous down to 1 μJy. In addition, we measure a microwave sky temperature of $\Delta T/T = (1.4 \pm 1.2) \times 10^{-5}$, consistent with microwave decrements we discovered near the center of our map.

We imaged a single field at (J 2000) RA = 13^h12^m and DEC = $+42°38'$ from October 1993 through January 1995 with the VLA, giving us 159 hr of good quality data. Observing with both the C and D configurations gave us a combined synthesized beam of FWHM $\approx$ 6". Our field of view as defined by the FWHM of the primary beam was 312". After proper editing and weighting of the data, we obtained a point source sensitivity of 7 μJy (5 σ). As the brightest source in our field of view was S = 273 μJy, our observations were *not* dynamic range limited.

2. Removing the Foreground Sources

The radio sources observed above our completeness limit in our field are discussed by Fomalont et al. elsewhere in these proceedings. Here we will focus on the subliminal radio sources. In order to gain information on the sky density of sources $\leq$ 7 μJy, we attempted to model the faint radio population. We used the following scheme.

1. We fit an integral source count to *all* sources $\geq$ 7 μJy within our field of view to empirically determine a source count $N(\geq S) = (17\pm2)S^{-1.2\pm0.2}$ per arcmin^2.

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2. We randomly populated an area 10 arcmin^2 in size between 0.2 - 300 μJy with point sources according to the above power law.
3. We calculated the visibility function for this simulated sky at the *identical* (u,v) point sampled by the observations and imaged the subsequent simulated data, including receiver noise.
4. We subtracted out all sources ≥ 7 μJy from the simulated map by isolating the (u,v) data associated with each source.
5. We preformed a statistical analysis on the resultant map, comparing it to our *observed* map with all sources ≥ 7 μJy subtracted out.

We find that the excess signal found in the center of our observed residual map is consistent with the contribution expected from faint radio sources between 7 - 1 μJy.

3. Isolating the Cosmic Microwave Background

Our observations are also well suited for small scale ($\theta \leq 1'$) CMB anisotropy searches. If we can accurately measure or estimate the relative contribution of the faint radio sources and the receiver noise, then we can measure the smoothness of the microwave sky. Our analysis included the following steps.

1. We preformed a variance analysis in 200" concentric rings about the phase center on our *simulated* residual maps (all sources ≥ 7 μJy removed), smoothed to 60".
2. We used our *observed* residual map, smoothed to 60", for a likewise variance comparison.
3. By dividing our master (u,v) data set into two equal halves, mapping each part identically, and then subtracting the two, we are left with an excellent measurement of the instrumental noise during our observations.

After accounting for receiver noise and faint radio sources, we find an excess signal which we attribute to CMB fluctuations.

4. Conclusion

Our CMB measurement is equivalent to $\Delta T/T = (1.4 \pm 1.2) \times 10^{-5}$. Although experimentally marginal, this is consistent with 'cool spots' we found at higher resolution ($\theta \approx 18"$). The most negative source has a microwave surface brightness of $\Delta T = -0.4$ mK. The most plausible physical mechanism is a SZ cluster, for which we derive a $M_{gas} \approx 10^{13}$ M_{solar} assuming $T_{ICM} \approx 1$ kev. This perspective cluster probably lies at $z = 2.56$, as we have detected two QSO's and three Lyα emitters at this distance in subsequent ground based narrow band imaging.