THE RADIO SOURCE POPULATION AT 15GHZ: IMPLICATIONS FOR CMB EXPERIMENTS

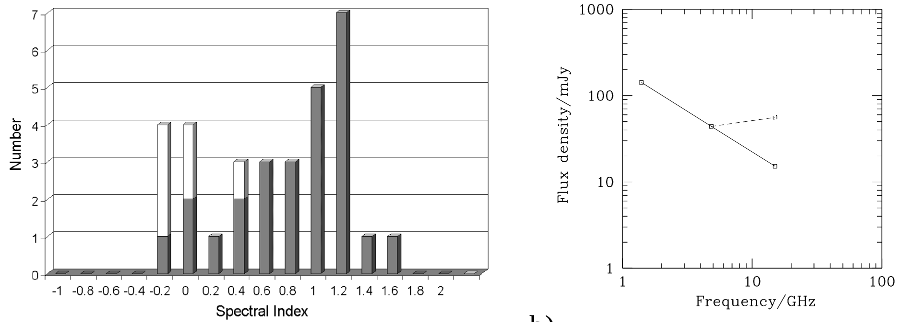
ANGELA C. TAYLOR
Cavendish Astrophysics, Cavendish Laboratory, Madingley Road, Cambridge CB3 0HE, England

We present the preliminary results of a survey of radio sources in one of the Very Small Array (VSA) fields at 15 GHz. This is the highest radio frequency at which a survey has been done that is relevant to the issue of radio source contamination in CMB experiments. We find that the population of sources at 15GHz does not match that predicted by extrapolation from low frequency surveys, and that critically, 15 percent of the observed radio sources were not predicted. The rising spectra of many of the sources and the implications for CMB experiments at cm-wavelengths are discussed.

1 Introduction

The Very Small Array (see Ben Rusholme, these proceedings) is a 14-element interferometer for mapping anisotropies in the CMB. Operating at around 30GHz, it has a flux sensitivity of order 20mJy in 28×7 hours. For practical primordial CMB observations, it is important to choose fields which are relatively free of Galactic and extragalactic foregrounds. With this in mind, the VSA fields have been selected for high Galactic latitude, low Galactic synchrotron and free-free emission, low dust and a lack of nearby large-scale structures. Critically, however, one must also deal with extragalactic radio sources. This poses a significant problem for cm-wavelength experiments since at present there exists no suitable sky survey between 5GHz and 300GHz.

The VSA team deals with radio sources in two ways. First, we use low frequency surveys (NVSS[1] 1.4 GHz and Green Bank[2] 4.85 GHz) to select fields in which there are predicted to be no extremely bright sources at 30GHz. Such sources would limit VSA maps by dynamic range. Second, we survey the selected fields for sources above 20mJy at 15GHz with the Ryle Telescope (RT). This enables the detection and subtraction of all sources with a spectral index as steep as -2 between 15GHz and 30GHz. Each source is then monitored at 30GHz by a separate interferometer working simultaneously with the VSA (see Keith Grainge, these proceedings).



a) b)

Figure 1: (a) Spectral indices, $\alpha^{15}_{4.85}$, of sources observed with the Ryle Telescope (flux density $\propto \nu^{-\alpha}$). Dark bars are observed sources that were predicted, white bars are sources which were **not** predicted. (b) An example of a predicted source spectrum (solid line) which differed significantly from the observed value (dotted line).

In the process of this work we will investigate the properties of radio sources at 15GHZ, the knowledge of which will be of major importance to other CMB experiments.

2 Surveying of fields at 15GHz using the Ryle Telescope

The preliminary results from a 28 deg^2 patch of sky show that the population of observed sources at 15GHz does not match that predicted by extrapolation from lower frequencies. Of the 70 sources predicted to be be brighter than 20mJy, 26 were actually found. Five further sources were found which were not predicted. The range of spectral indices between 4.85GHz and 15GHz for the observed sources is shown in Figure 1(a). In the assessment of source contamination in CMB experiments, it has generally been assumed that at high frequency most sources have spectra falling with frequency. Our results, however, show a significant population of sources with flat and rising spectra. Furthermore, the majority of such sources would not have been predicted by the extrapolation of source counts from lower frequencies. An example of such a source is given in Figure 1(b). It is possible that the apparent rise in spectral index is due to variability in the source.

3 Conclusions

These preliminary results have shown that extrapolation from lower frequency surveys will not deal adequately with radio source contamination. Fifteen percent of the sources actually found above 20mJy at 15GHz were not predicted by extrapolation, and a large fraction of rising- and flat-spectrum sources have been found. In order to perform effective source subtraction, one must simultaneously observe sources at the same frequency as a CMB observation enabling the correct subtraction of both variable and rising spectra sources.

Acknowledgments

Many thanks to Guy Pooley and Liz Waldram who are undertaking the surveys using the Ryle Telescope.

References

1. J.J. Condon *et al*, 1998, AJ, 115, 1693

2. P.C. Gregory, J.J. Condon, 1991, ApJS, 75, 1011