CALIBRATION ISSUES IN THE SEARCH FOR LARGE-SCALE ANISOTROPIES IN THE 87 GREEN BANK AND PARKES-MIT-NRAO SURVEYS

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1. Introduction

Until recently, there were no large scale radio surveys which were sensitive enough to have a sufficient number of sources to detect a dipole anisotropy. The 87 Green Bank (87GB) (Gregory and Condon, 1991) and Parkes-MIT-NRAO (PMN) (Griffith, 1993; Griffith *et al.*, 1994, 1995; Wright *et al.*, 1994) radio surveys are the first such efforts and are the most complete radio surveys to date. We would like to analyze the source counts in these surveys in order to test the isotropy of the sky distribution of extragalactic sources at cosmological redshifts. Of particular interest is a dipole anisotropy, which could arise from local motion with respect to the rest frame of extragalactic radio sources. Any detected anisotropy will give information about the source sky distribution at a redshift of z $\sim$ 1 (Condon, 1988), an epoch between the COBE observations at $z \sim 1000$ and the local universe.

2. Data Calibration Issues

Accurate flux calibration is very important when searching for the cosmic dipole effect. One must ensure that the surveys are properly calibrated both internally and with respect to each other before a search is undertaken. The 87GB and PMN surveys overlap in the region $0° < \delta < +10°$, and we can use the measured fluxes of common sources to compare the flux calibration between the two surveys. The left plot in Figure 1 shows PMN flux vs. 87GB flux with the line $S_{87GB} = S_{PMN}$ (error bars are not shown). At low fluxes ($S < 70$ mJy), there is a significant bias in the distribution. The right plot in Figure 1 shows the binned average of $(S_{PMN} - S_{87GB})$ as a function of S_{87GB} for sources with $50 < S_{87GB} < 100$ mJy. There is a significant offset below about 70 mJy. However, above 70 mJy there does not appear to be a clear convergence to zero offset. These results are problematic when considering the calibration of the surveys with respect to each other. Both surveys also exhibit calibration variations internally as a function of declination.

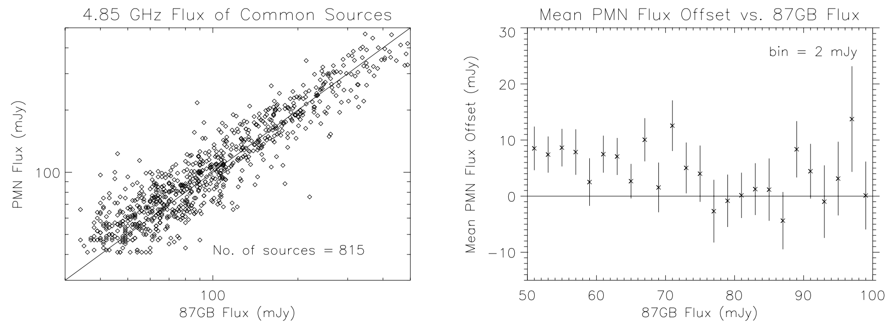

Figure 1. Left: Log plot of PMN flux vs. 87GB flux for sources common to both surveys. The diagonal line represents the expected relation $S_{GB} = S_{PMN}$. Right: Average flux offset (PMN minus 87GB) vs. 87GB flux for common sources between 50 and 100 mJy.

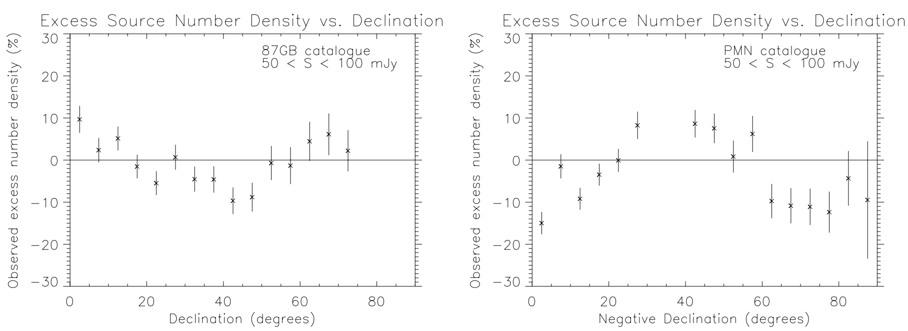

Figure 2. Observed excess surface density from the global average as a function of declination for sources with $50 < S < 100$ mJy in the 87GB (left) and PMN (right) catalogues.

Figure 2 shows the observed excess surface density from the global average for sources with $50 < S < 100$ mJy in 5 degree rings of constant declination for both catalogues. One can see parabolic patterns in the data, which may be related to the zenith angle gain curves for each telescope. Since the magnitude of the excess is of order 10%, the expected dipole ($v \sim 500$ km/s) will be overwhelmed by these effects. Thus the surveys must be calibrated both internally and with respect to each other before a complete search for large-scale anisotropies is undertaken.

References

Condon, J.J. 1988. in *Galactic and Extragalactic Astronomy*, eds. Verschuur, G.L., and Kellerman, K.I., Springer-Verlag, 641
Gregory, P.C., and Condon, J.J. 1991. *Ap. J. Supp.*, **75**, 1011
Griffith, M.R. 1993. MIT Ph.D. Thesis
Griffith, M.R., Wright, A.E., Burke, B.F., and Ekers, R.D. 1994. *Ap. J. Supp.*, **90**, 179
Griffith, M.R., Wright, A.E., Burke, B.F., and Ekers, R.D. 1995. *Ap. J. Supp.*, **97**, 347
Wright, A.E., Griffith, M.R., Burke, B.F., and Ekers, R.D. 1994. *Ap. J. Supp.*, **91**, 111