PRELIMINARY FLUX DENSITY MEASUREMENTS OF A FEW STRONG SOUTHERN RADIOSOURCES AT 45 MHz

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RESUMEN. Se presentan los resultados preliminares de medidas de densidad de flujo de unas pocas radiofuentes intensas usando como calibradores Hydra A y Fornax A. Se discuten las causas de error y las aplicaciones futuras del método usado.

ABSTRACT. We report the preliminary results on the flux density measurement of a few strong southern radio sources using Hydra A and Fornax A as calibrators. We discuss the causes of errors and the future prospects.

I. INTRODUCTION

Little work has been done at the low-frequency end of the spectrum of southern radio sources. The lowest frequency at which there is an extensive survey of flux density measurements is 80 MHz (Slee 1977). The number of Culgoora-3 sources south of the equator listed at frequencies between 10 and 160 MHz in the catalogue of Slee *et al.* 1982 is shown in Table 1.

TABLE 1

Number N of southern sources listed between 11 and 160 MHz in Slee *et al.* 1982. δ_m is the lowest declination reached by the survey and S_m is the minimum flux density detected.

f(MHz)	10.0	16.7	29.9	38	80	160
N	4	29	99	61	993	1007
δ_m(°)	-2	-4	-64	∿ -9	-45	-45
S_m(Jy)	95	20	30	∿ 13	3	∿ 1.7
Reference	1	2	3	4	5	5

References: 1 Bridle and Purton 1968
2 Braude *et al.* 1978, 1979, 1980
3 Finlay and Jones 1973
4 Williams *et al.* 1966
5 Slee 1977

There is a lack of observations below 80 MHz, and this is even more noticeable towards the far south. The only survey below 80 MHz covering a large fraction of the southern hemisphere is that of Finlay and Jones, at 29.9 MHz. However, it includes only about 10% of the sources observed at 80 MHz.

One of the purposes in building the large radiotelescope of the University of Chile, at Maipú, was to make extensive flux density measurements of southern radio sources at a relatively low frequency. This paper describes the observations made at 45 MHz of a few strong radiosources, the preliminary results obtained and the plans for the near future.

II. THE OBSERVATIONS

The observations were made with the radiotelescope at the Maipú Radio Observatory that consists of a rectangular filled array of 528 full wavelength dipoles accepting E-W linear polarization. The dipoles cover 11680 m^2 and extend over a 13867 m^2 reflector plane. The maximum antenna collecting area, obtained with the antenna pointing to the zenith, is of 9650 m^2. A Butler matrix provides four independent beams aligned on the meridian. The beams have a resolution of 4°6 (α) x 2°4 (δ) and are separated by 1°8 in declination. The antenna is a transit instrument and can be steered in declination by electric phasing. We measured the antenna radiation diagram in the E-W as well as in the N-S direction and found that the measured values are very close to those predicted by the theory. The relative intensity of a source in two or three beams allowed a determination of the antenna pointing.

The receiver noise temperature is of 210 K, therefore the minimum temperature detectable by the system is determined by the sky background which may vary between 3000 and 90000 K at this frequency (May *et al.* 1984a). The observations were made with a 1 MHz bandwidth. The receiver output, expressed in temperature was registered in analog chart recorders with a 10 s integration time. The information as also stored in punched tape but with a time constant of 60 s. Temperature calibrations were made every hour by inserting a saturated diode noise generator in place of the antenna.

A detailed description of the antenna has been given elsewhere (May *et al.* 1984b). The observations were made between November 1982 and September 1983.

III. DISCUSSION AND RESULTS

The measured fluxes are referred to Fornax A and Hydra A, which were used as calibrators. From the spectral information found for them we adopted a flux density of 1020 and 1400 Jy for Hydra and Fornax, respectively.

The method of measurement consisted in pointing the antenna in declination so that the calibrator was on the axis of one of the two central beams within a few arc min. This permitted to know the pointing of the four beams and to determine a calibration factor that transformed the temperature scale into a flux density scale. Because of ionospheric and climatic conditions this factor varies slowly from day to day, however we assumed that is stayed constant during 24 hrs.

For the position of the beams corresponding to a calibrator we surveyed a strip extending 7°8 in declination. For Fornax and Hydra we explored the ranges $-42°2 < \delta < -32°4$ and $-15°8 < \delta < -8°0$, respectively.

The study presented here is based on a inspection of the analog records. The selection criterion was that a radio source should be obviously seen, it should not be on a steep gradient of the background radiation, and the data should be free of interference and other problem.

In the two strips examined we found only eight sources that fullfilled the required conditions. Knowing the source precessed declination and the corresponding beam pointing we determined the distance of the source to the beam axis. With this information and the theoretical N-S radiation diagram we referred the measured flux to the beam axis. The temperature thus obtained was transformed into flux density by means of the calibration factor described earlier.

The results are shown in Table 2.

There are several sources of error in our determination of the flux densities. First, we have the uncertainty in establishing the baseline above which the source amplitude is measured. This is a problem considering that the HPBW corresponds to about 22 minutes of time at the declinations involved. Second, there are diurnal changes in the signal level that depend on climatic conditions affecting the electrical properties of the transmission lines. We suspect that the ionosphere sometimes attenuates the incoming radio waves and produces variation in the output signal level. These variations cannot be corrected by the calibrations and we will have to wait until we have completed our map of the sky to use it as a temperature reference. So far we have measured the calibration factor each day and we have assumed that it stays constant

TABLE 2

Flux Densities at 45 MHz

Sources	S(Jy)	Sources	S(Jy)
0038-09	64	1136-13	96
0131-36	97	1424-11	35
0521-36*	61	1449-12	29
0806-10	46	2032-35	33

* Variable.

throughout the day. Third, there are diurnal changes in the preamplifiers gain due to variations in the ambient temperature. These changes are corrected by the calibration, however they were not accounted for in the present work. Finally, we have relied on the validity of the theoretical N-S radiation diagram of the antenna. This was checked experimentally in a couple of points, as described earlier, and we found that the observations agree with the theory, however, some minor deviations may be present.

At this time is difficult to estimate the error in the measurements due to those effects. For this reason only strong sources observed under optimum condition were selected.

The 45 MHz points fit well the spectrum defined by the observations at 29.9, 80 and 160 MHz. The exception are 0521-36 and 1136-13 that are lower and higher, respectively, than expected. The first case could be explained because the source 0521-36 is a known variable and the 29.9 MHz observations were made presumably in 1973 while the 80 and 160 MHz observations were made in 1966.0. The second source has not been reported as variable however we do not know if variability has been sought for.

To the best of our knowledge our measurements of 1424-11 and 1449-12 correspond to those at the lowest frequency ever observed.

The eight sources observed are extragalactic and have been optically identified.

IV. CONCLUSIONS

Using some characteristics of the Maipú antenna we have developped a technique to measure flux densities or radio sources relative to primary calibrators. Because we have not completed as yet a computerized data processing program we have applied the technique to a few strong radio sources using analog records. Based on this preliminary study and considering the improvements we will introduce in the data processing and analysis we estimate that we will be able to reach flux densities of the order of 10 Jy. Using Hydra and Fornax as primary calibrators we plan to cover a large fraction of the southern sky with a network of secondary calibrators and to conduct an extensive and more accurate survey of radiosources.

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