Miyun 232 MHz Survey and Some New Imaging Techniques

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Abstract.

A new meter-wave survey of sky region north of declination +30° is carried out with the Miyun 232 MHz Synthesis Radio Telescope(MSRT). The instrument, observation and some new imaging techniques are briefly described in this paper. As first result, two 8° × 8° regions centred respectively at α : $00^h41^m, \delta : 41°12'$ and $\alpha : 07^h00^m, \delta : 35°00'$ were observed and reduced. On the average 4 - 5 sources per square degree are recorded with position accuracy of 5" / S(Jy). The accuracy of flux determination is limited by background fluctuation which is about 30 mJy. The catalogue is complete for sources with flux larger than 0.25 Jy.

Key words: survey – radio sources – imaging

1. The Instrument

The Miyun 232 MHz Survey is a moderately deep meter-wave survey. Most part of the sky north of Dec. 30 degree has been observed. The survey has its working frequency located between 6C(Baldwin, J. et al., 1985) and B3 Surveys(Ficarra, A. et al., 1985), and has resolution and sensitivity similar to them.

The Miyun aperture synthesis system (Wang, 1984), working at 232 MHz and 327 MHz, consists of an E-W array of 28 dishes each of 9m in diameter. The characteristics of the array are summarized in Table 1. All the combinations $A_i \times B_j (i = 1-16, j = 1-12)$ are used to form 192 interferometers with baselines incrementing by 6 meters from 18 meters to 1164 meters. In a complete set of Earth Rotation Synthesis, when weighted in a natural manner, the MSRT gives an overall resolution of $3.8' \times 3.8' csc\delta$ and a thermal noise limited sensitivity of 0.01 Jy/beam for the 232 MHz system.

2. Some New Imaging Techniques

Gain and phase calibrations for each array element were made by observing Cyg A for 10 minutes before or after the observation. In the late 1985, with the help of Dr. E.B. Fomalont the AIPS software package was installed in Beijing Astronomical Observatory. Since then, AIPS has been used for the mapping, CLEAN and some self-calibration of the MSRT maps.

Except for these ordinary data reductions, some special imaging techniques were used in to improve the quality of MSRT maps.

2.1. Equality of Noise

In general, making gains of channels to become uniform is a criterion of gain self-calibration. It may cause a rise of map background fluctuation, when there are a little bigger unbalance of gain between different channels. That is due to common gain self-calibration enlarge the noise of some channel which have low level signal of visibility. This procedure can be expressed as following.

$$W(t,b) = G(t,b) \times (W_s(t,b) + W_n(t,b)) \quad (1)$$

The second term $G(t,b) \times W_n(t,b)$ means the noise is enlarged for imaging.

To solve this problem, the steps adopted are

(1)to subtract all sources from the visibility data after ordinary calibration.

(2)using the G(t,b) to correct the new data.

J.G. Robertson and W.J. Tango (eds.), Very High Angular Resolution Imaging, 352–354.

TABLE I
The characteristics of the MSRT

observing frequency	232 MHz
aerials	9 m parabolic
number of aerials	28
primary beam	$10^{\circ} \times 12^{\circ}$
baseline	1164 m East-West
spacing interval	6 m
number of baselines	192
min. and max. baselines	18 m - 1164 m
synthesised beam width(232)	$3.8' \times 3.8' csc\delta$
trans. frontend noise	$100^{\circ} K$
band width	1.5 MHz
sampling interval	10 sec.
rms noise/spacing/sampling	10 Jy(232)
path compensation	digital
correlator	96 dig.(1 bit)

(3)to add all sources back to the data modifited.

2.2. NEW HIGH-PASS FILTER

Since most source can be consider as point sources for the resuolution of $3.8' \times 3.8' csc\delta$ of MSRT. A new high-pass filter procedure was designed for to clear a clean map, called CL map.

First a map, called BG map, from which all sources were subtracted and a map, called DV map, secondary derivative of the CL map are created. Then the BG map is smoothed by a given window whch is 3 - 5 times larger than the beam size. At each position of individual source, the data of BG map inside the beam is excluded in the smoothing procedure. The position list is obtained from the DV map. Final the new BG map is subtracted from the CL map.

2.3. SPECIAL CALIBRATION AND CLEAN

A special self-calibration and CLEAN method were developed for regions around strong sources. Here is an example of the region around Cyg A. To get a better results the key is to creat a good initial model of the imaging. The strong source Cyg A is partially resolvéd in our observations. By model fitting a better initial model of Cyg A is created. It is essentially a double-point source, but the spaceing between the two components is 81 per cents of the spacing 106" got from high frequency observations. The flux of the two components are about equal. Using this model and a self-calibration programme developed by ourself, a much better map of the field was obtained.

After the imaging a new method of CLEAN on map-plane is applyed to improve the map futhermore. Finaly a map with dynamic about 10000 was obtained. From it a very good map of G78.2+2.1 and several point sources were obtained. The source nearest to the Cyg A is just one degree apart from it. It is 2000+412 and its flux at 232 MHz is

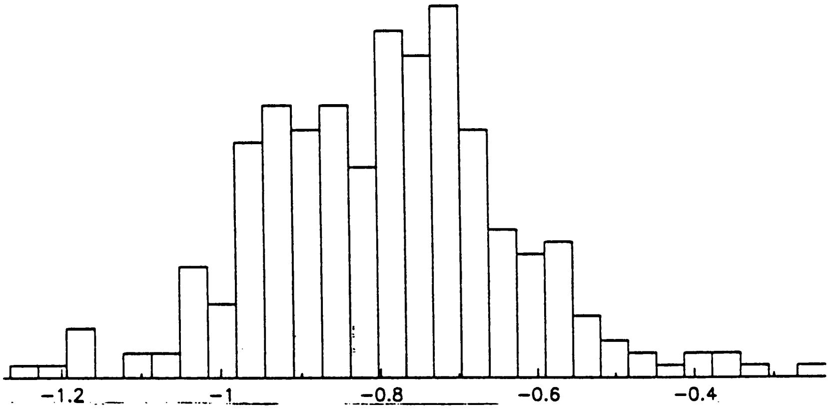

Fig. 1. The distribution of spectrum index of 286 sources selected from this survey between 232 MHz and 4850 MHz.

about 9.08 Jy.

3. The Catalogue

Fig. 1 shows the spectral indexes distribution stated from the source list of the two maps reproted in this paper. Since the limitation of pages, some results are sumrized only. The paper and catalogues of the two fields will be published by A. Ap. Suppl..

In the source list of the two fields, the following informations were listed for each source. In total 687 sources with flux densities larger than 0.20 Jy were listed. Items (1) to (8) in the list are: (1) name of the sources, (2) α(1950.0), (3) δ(1950.0), (4) peak flux density (Jy), (5) integrated flux density(Jy), (6) local zero level (Jy), i.e. rms of background fluctuation around the source., (7) name in 87GB catalogue, and (8) estimated spectral index (232 MHz to 4850 MHz).

Several interesting sources were found such as extended sources, steep spectra sources, and sources with convex sprectra.

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References

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