A NEUTRAL HYDROGEN SURVEY OF THE LARGE MAGELLANIC CLOUD:
APERTURE SYNTHESIS AND MULTIBEAM DATA COMBINED

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Received 2002 May 1; accepted 2003 May 16

ABSTRACT

Recent H i surveys of the Large Magellanic Cloud (LMC) with the Australia Telescope Compact Array and the Parkes multibeam receiver have focused, respectively, on the small-scale (<20') structure of the interstellar medium (ISM) and the large-scale (>1') structure of the galaxy. Using a Fourier-plane technique, we have merged both data sets, providing an accurate set of images of the LMC sensitive to structure on scales of 15 pc upward. The spatial dynamic range (2.8 orders of magnitude), velocity resolution (1.649 km s^{-1}), brightness temperature sensitivity (2.4 K), and column density sensitivity (7 \times 10^{18} cm^{-2} per 1.649 km s^{-1} channel) allow for studies of phenomena ranging from the galaxy-wide interaction of the LMC with its close neighbors to the small-scale injection of energy from supernovae and stellar associations into the ISM of the LMC. This paper presents the merged data and size spectrum of H i clouds, which is similar to the typical size spectrum of the holes and shells in the H i distribution. The H i clouds in the LMC have been identified by defining a cloud to be an object composed of all pixels in right ascension, declination, and velocity that are simply connected and that lie above the threshold brightness temperature.

Subject headings: galaxies: ISM — ISM: atoms — Magellanic Clouds — radio lines: galaxies

1. INTRODUCTION

High-resolution H i observations of nearby galaxies allow the study of many aspects of their dynamics, morphology, and interstellar physics. Measurement of the vertical H i distribution and velocity dispersion, for example, allows the mass-to-light ratio and dark matter content of galaxy disks to be studied (Olling 1996). The shape of the inner velocity field, using H i as a tracer, can discriminate between different halo models (de Blok et al. 2001). Also, the relationship between H ii regions and H i holes says much about the evolution of galaxies and the propagation of star-forming regions (Walter & Brinks 2001).

The LMC, as the nearest gas-rich galaxy to our own, has been the subject of several H i studies (Luks & Rohlfis 1992; McGee & Milton 1966; Dickey et al. 1994). The advantage of studying the LMC in H i is that it is the nearest galaxy to our own with a distance of 50–55 kpc (Feast 1991), it is presented nearly face-on, and it is a very gas-rich and active star-forming galaxy; thus, it allows for a detailed study of the structure, dynamics, and interstellar medium of a star-forming galaxy at close range. The early single-dish observations of galaxies and the propagation of star-forming regions (Westerlund & Mathewson 1966; McGee & Milton 1966). A very spectacular example of such a shell associated with the major star-forming region Constellation III was described by Dopita, Mathewson, & Ford (1985).

However, its location in the far south means that high-resolution studies had to await the advent of the Australia Telescope Compact Array (ATCA). The advent of ATCA finally allowed us to take full advantage of the aperture synthesis technique in southern hemisphere observations, and our recent high-resolution H i survey of the Large Magellanic Cloud (LMC) revealed that the structure of the neutral atomic interstellar gas is dominated by numerous shells and holes as well as complex filamentary structure (Kim et al. 1998). Its huge angular scale (~8' for the inner disk) required effective observing techniques and mosaicking methods (Staveley-Smith et al. 1997) and required the development of new deconvolution algorithms (Sault, Staveley-Smith, & Brouw 1996).

At the largest scales, understanding the interaction of the LMC with the Galaxy and the Small Magellanic Cloud (SMC) is important (Putman et al. 1998; Weinberg 2000). Also important is knowing the viewing geometry of the disk of the LMC (van der Marel & Cioni 2001), its mass and dark matter content (Kim et al. 1998; Alves & Nelson 2000), and the origin of the off-center bar (Zhao & Evans 2000; Gardiner, Turfus, & Putman 1998). At intermediate scales, the origin of the supergiant shells is tantalizing. Are supernovae and stellar winds (Dopita, Mathewson, & Ford 1985; Chu & Mac Low 1990; Olsen, Kim, & Buss 2001) sufficient, or are other factors such as instabilities in the ISM (Wada, Spaans, & Kim 2000), high-velocity cloud collisions (Tenorio-Tagle & Bodenheimer 1980), or gamma ray bursts (Efremov, Elmegreen, & Hodge 1998; Efremov, Ehlerova, & Palous 1999) important? At smaller scales, the structure of the ISM, the structure of photodissociation regions, and the detailed feeding and feedback of star-forming regions are important for understanding their evolution.

In this paper, we perform the last step of our high-resolution H i survey of the LMC by combining the already-made

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6 The Australia Telescope Compact Array is funded by the Commonwealth of Australia for operation as a National Facility managed by CSIRO.
in R.A. and decl., respectively, and centered on 05h20m, −68° 44′ (J2000). In a single scan, the spacing between adjacent tracks is 9′.5, which is smaller than the mean FWHM beam width of 14′.1, but greater than the Nyquist interval (λ/2D) of 5′.7. Therefore, six scans are interleaved in each of the principal scan directions, resulting in a final track spacing of 1′.6. In total, 12 × 6 R.A. scans and 11 × 6 decl. scans were made. Seven scans were dropped or edited out due to drive problems, leaving a total of 131 scans consisting of a total of 29 hours of on-source integration on each of seven beams. The average integration time per beam area is 360 s for both polarizations.

The scan rate of the telescope was 1′0 minute−1, and the correlator was read every 5 s. Therefore, the beam was slightly broadened in the scan direction to 14′.5. After averaging orthogonal scans, the effective beam width reduces to 14′/3. The central observing frequency was switched between 1417.5 and 1421.5 MHz, again every 5 s. This allowed the bandpass shape to be calibrated without spending any time off-source. A bandwidth of 8 MHz was used with 2048 spectral channels in each of two orthogonal linear polarizations.

H i emission from the LMC appeared within the band, at both frequency settings. After bandpass calibration, the data from both settings were shifted to a common solar barycentric reference frame. The velocity spacing of the multibeam data is 0.82 km s−1, but the final cube was Hanning-smoothed to a resolution of 1.6 km s−1. The useful velocity range in the final cube (i.e., after excluding frequency side lobes of the LMC and the Galaxy, and band-edge effects) is −66 to 430 km s−1.

Bandpass calibration, velocity shifting, and preliminary spectral baseline fitting were all done using the AIPS++ LiveData task. Subsequently, the data were convolved onto a grid of 4′ pixels using a Gaussian kernel with a FWHM of 8′/0. This broadens the effective, scan-broadened, beam

To provide the complete map at low spatial resolution to complement the ATCA data, observations were taken with the inner seven beams of the Parkes Multibeam receiver (Staveley-Smith et al. 1997) on 1998 December 13–17. The receiver was scanned across the LMC in orthogonal east-west and north-south great circles, and the receiver was continuously rotated such that the rotation angle was always at 19′1 to the scan trajectory, thus ensuring uniform spatial sampling of the sky. The area covered was 13′ by 14′ in R.A. and decl., respectively, and centered on 05h20m, −68°44′ (J2000). In a single scan, the spacing between adjacent tracks is 9.5′, which is smaller than the mean FWHM beam width of 14′/1, but greater than the Nyquist interval (λ/2D) of 5′7. Therefore, six scans are interleaved in each of the principal scan directions, resulting in a final track spacing of 1′6. In total, 12 × 6 R.A. scans and 11 × 6 decl. scans were made. Seven scans were dropped or edited out due to drive problems, leaving a total of 131 scans consisting of a total of 29 hours of on-source integration on each of seven beams. The average integration time per beam area is 360 s for both polarizations.

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width of the inner seven beams from 14′3 to about 16′4. Residual spectral baselines were removed by fitting polynomials in the image domain (MIRIAD task CONTSUB).

The multibeam data were calibrated relative to a flux density for PKS B1934–638 of 14.9 Jy at the observing frequency. The brightness temperature conversion factor of 0.80 K Jy$^{-1}$ was established by an observation of S9 ($T_B = 85$ K; Williams 1973). On the same scale, we measured a brightness temperature for pointing 416 in the SMC (00h47m52.6s, $-$73°02′19.7s, J2000) of $T_B = 133$ K, compared with the 137 K measured by Stanimirović et al. (1999). The 3% difference is probably due to the different characteristics of the feeds used in the two observations, and residual uncertainties in absolute bandpass calibration.

The rms noise in the line-free region of the cube is 27 mK, which is close to the theoretical value.

2.2. Combining ATCA and Parkes Observations

Several techniques are available to combine the interferometric and single-dish data. The data can be combined during a joint maximum entropy deconvolution operation. Alternatively, the single-dish data can be used as a “default” image in a maximum entropy deconvolution of the interferometer data. Another possibility is to feather together (a linear merging process) the single-dish and interferometer images. Stanimirović et al. (1999) have used an approach where the interferometer and single-dish image are added together before deconvolution, and then deconvolution is performed with a modified point-spread function. Tests by Stanimirović et al. (1999) found that the different techniques produced quite similar results. Given this, and as we already had a deconvolved interferometric

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**Fig. 2.**—Individual channel maps for the H i data cube in the LMC. The heliocentric velocity is marked at the top left in each panel. Each panel is the average of five adjacent channels of width 1.649 km s$^{-1}$, giving a panel spacing of 8.2 km s$^{-1}$. The pots cover most of the H i emission in the LMC from 210 to 334 km s$^{-1}$. Black represents regions with the highest brightness temperatures of 136.7 K; white represents 0 K.
cube, and as the computational requirements to reperform a deconvolution of these data are large, we have used an image feathering approach.

The technique we have used is a variant of the approach described by Schwarz & Wakker (1991). As the Parkes and ATCA images give accurate representations of the LMC at short spacings and mid to long spacings, respectively, a composite image can be formed by filtering out the short spacing data from the ATCA image and then adding the Parkes image. This process is most easily visualized in the Fourier domain as in Figure 1, which shows the expected amplitude as a function of spatial frequency of a point source for our observations. The Fourier transform of the Parkes images were added to the final images with no weighting (i.e., “natural” weight in interferometric nomenclature). The deconvolved ATCA data were also Fourier-transformed, but by down-weighting the lower spatial frequencies such that the combined weight of the Parkes and ATCA data was the same as the response to a 10 Gaussian. The MIRIAD task IMMERGE was used.

Before combining, the Parkes image was interpolated onto the same coordinate grid as the ATCA mosaicked image. Also the residual primary beam attenuation remaining in the ATCA image was applied to the Parkes image (the mosaicking process we have used does not perform full primary beam correction when this would result in excessive noise amplification). In order to perform the combination of the Parkes and ATCA observations, we need to ensure that the flux calibration between the two data types are consistent. Ideally, we would like to find the ratio of the flux density of an unresolved point source in the field. We have estimated this calibration factor by examining data in the Fourier plane between 21 and 31 m—data in this annulus are well measured by the Parkes and mosaicked ATCA observations. After tapering the ATCA data to the same resolution as the Parkes data, we found that a scale factor of

![Figure 2](http://example.com/fig2.jpg)
1.3 minimized the $L_1$ difference between the interferometer and single-dish Fourier components (the real and imaginary parts of the data were treated as distinct measurements in the fitting). Note that the scale factor (and indeed the entire feathering process) requires a good estimate of the resolution of the Parkes image. The effective beam size of 16$''$/9 was adopted as it gave a scale factor independent of spatial frequencies (Stanimirović et al. 1999).

The resolution of the combined H $\text{I}$ image of the LMC is 1.0, which is the same as for the ATCA interferometer map. The rms noise of the combined map, determined from the line-free parts of the final data cube, is $\sim$15 mJy beam$^{-1}$. This corresponds to a brightness temperature sensitivity of $\sim$2.4 K.

3. DATA PRESENTATION

To assist the comparison, we display in Figure 2 the individual channel maps from the combined H $\text{I}$ ATCA map with the Parkes single-dish map. This figure can be compared with Figure 2 of Kim et al. (1998). The individual channel maps have a velocity resolution of 1.649 km s$^{-1}$ and cover a velocity range of $V_{\text{HEL}} = 205$ km s$^{-1}$ to $V_{\text{HEL}} = 334$ km s$^{-1}$. However, the H $\text{I}$ emission is detected mostly in the velocity range of $V_{\text{HEL}} = 190$–387 km s$^{-1}$. The peak H $\text{I}$ surface brightness image and the column density image of the LMC are shown in Figure 3 and Figure 4. The peak brightness temperature is 136.7 K at R.A. = 05h40m43s, decl. = $-69^\circ$48$'$49$''$7 (J2000). The peak column density of $7.3 \pm 0.3 \times 10^{21}$ cm$^{-2}$ in the $V_{\text{HEL}} = 225$–310 km s$^{-1}$ assuming that the H $\text{I}$ is optically thin at this point.

There is a remarkable correspondence between the features of this map and the H $\text{I}$ emission obtained from the previous ATCA survey (Kim et al. 1998). For example, the spiral structure is clearly seen in the individual channel maps (Fig. 2b) and the peak H $\text{I}$ surface brightness map (Fig. 3) as well as its integrated map (Fig. 4). In contrast to the optical image of the LMC (Kim et al. 1999; our Fig. 5a), both the...
ATCA map and ATCA+Parkes combined map show that the H\textsc{i} distribution is uniform and that there is no bar feature corresponding to the optical one. The huge H\textsc{i} hole of diameter about 1.2 kpc resides between the southern (de Vaucouleurs & Freeman 1972) and northern spiral arm.

The large-scale distribution of hydrogen in the 30 Dor region and the south of 30 Dor region in the coordinate range $05^h49^m < R.A. < 05^h46^m$, $-73^\circ00' < \text{decl.} < -68^\circ30'$ displays two large sheets of gas having a relative difference in the line-of-sight velocity about 40 km s$^{-1}$ but with relatively small internal velocity dispersions. The general shape of this feature seen in the position-velocity ($P$-$V$) diagram (Fig. 5) can be explained as the disk (D-) component and a second surface (L-component), discussed by Luks & Rohlfs (1992), which is possibly a region affected by the ram-pressure associated with the motion of the LMC through the outer halo of our Galaxy (Kim et al. 1998). However, many arclike structures seen in the $P$-$V$ diagram are likely to originate from expanding shells (Kim et al. 1999), although it is very difficult to distinguish between the components from expanding shells and intrinsic separate disk components (e.g., the L- and D-components) as a result of combined action of multiple expanding shells and local random motion.

4. SIZE SPECTRUM OF H\textsc{i} SHELLS AND CLOUDS

The structure of the neutral atomic ISM in the LMC shows a complex distribution of H\textsc{i} emission, which is chaotic with hundreds of clouds, shells, arcs, rings, and filaments. The shell-like structures seen in the ATCA map still dominate the structure of the neutral atomic ISM in the LMC revealed by the ATCA+Parkes combined map. The previous visual survey of H\textsc{i} shell candidates chosen from the ATCA H\textsc{i} data cube (Kim et al. 1999) has been reinvestigated from the current combined data set. Here we
confirm that the H\textsuperscript{i} supergiant shells reported in Kim et al. (1999) are indeed seen in the combined data sets and presented in Figure 6 in this paper. Figure 6 is the same as Figure 2 of Kim et al. (1999).

The physical parameters of the individual supergiant shells are summarized in Table 1. The mean column density of neutral hydrogen in the LMC is in the order of \(2.8 \times 10^{21}\) cm\(^{-2}\). Assuming a mean column density is distributed uniformly over the disk thickness of \(D = 360\) pc (Kim et al. 1999), we estimate a mean gas particle density of \(n_{H} \approx 2\) cm\(^{-3}\). We may estimate the amount of kinetic energy of the H\textsuperscript{i} gas associated with the expanding H\textsuperscript{i} shells, using their derived sizes and expansion velocities. A total predicted kinetic energy of the interstellar gas associated with H\textsuperscript{i} expanding supershells is \((3.9 \pm 1.3) \times 10^{53}\) ergs over the mean dynamical age of the expanding shell \(\sim 6\) Myr. This result is remarkably similar to the total kinetic energy deposited from the stellar winds, \(~4.3 \times 10^{53}\) ergs over 6 Myr, referring the results derived from a total ionizing flux of \(\sim 6.7 \times 10^{51}\) photons s\(^{-1}\) for UV sources in the LMC (Smith et al. 1987) and using the relationship between the ionizing photon flux and the stellar wind mechanical luminosity, \(L_w/N_e = 3.2 \times 10^{-13}\) ergs photon\(^{-1}\) (Wilson 1983).

The distribution by number of the H\textsuperscript{i} shells as a function of their radius is presented in Figure 17 of Kim et al. (1999). In the range 100–1000 pc, the data are consistent with a power-law distribution of slope \(s = -1.5 \pm 0.4\). In order to compare the size spectrum of the H\textsuperscript{i} shells in the LMC with a size spectrum of H\textsuperscript{i} clouds, we investigate the H\textsuperscript{i} cloud candidates from the ATCA+Parkes combined data cube. It is well known that the interstellar medium, atomic as well as molecular, is distributed in a hierarchical ensemble of clouds. Such clouds or clumps could be a condensation formed during the thermally unstable cooling. The gas may initially be in either an atomic or a molecular state depending on the local physical conditions (density, excitation temperature, etc.). As the volume densities increase, the gas phase turns to molecular. A recent CO\((J=1-0)\) and CO\((J=2-1)\) study of the two nearly face-on galaxies NGC 628 and NGC 3938 shows that the velocity dispersion is remarkably constant with radius, \(6\) km s\(^{-1}\) for NGC 628 and \(8.5\) km s\(^{-1}\) for NGC 3938, and of the same order as the H\textsuperscript{i} velocity dispersion (Combes & Becquaert 1997). The
similarity of the CO and H\textsc{i} dispersions suggests that the two components are well mixed and are only two different phases of the same kinematical gas component. The position of H\textsc{i} clumps can be well matched with CO emission maps (Cohen et al. 1988; Israel et al. 1993; Fukui et al. 1999). A large fraction of the H\textsc{i} clumps have a detectable 100 \mu m emission. Similarly, where the H\textsc{i} clumps are more intense, the clumps are associated with CO clouds. The large-scale association between H\textsc{i} and CO is clearly of central interest for studies of cloud and star formation in galaxies (Elmegreen & Elmegreen 1987).

The shapes of H\textsc{i} clouds are difficult to define, and the identification of clouds is still a subjective issue. However, the majority of H\textsc{i} clouds can be redefined as H\textsc{i} clumps at small scales in either larger sheets or filaments rather than spherical blobs. The present H\textsc{i} aperture synthesis survey of the LMC is particularly well suited to reach the statistical characteristics of H\textsc{i} clouds or clumps. Since the distance of the LMC is known as 55 kpc (Feast 1991) and the LMC is nearly face-on disk galaxy, confusion along the line of sight is negligible. We have identified and cataloged H\textsc{i} clouds in the LMC by defining a cloud to be an object composed of all pixels in right ascension, declination, and velocity that are simply connected and that lie above the threshold brightness temperature (Scoville et al. 1987; Lee et al. 1990 1997). We applied this method rather than Gaussian clumping method as the other may generate all Gaussian clumps, which are not realistic in general. In fact, most clouds do not have Gaussian profiles, and this is especially true for H\textsc{i} clouds. Ideally, one would like to define clouds with a 0 K threshold temperature. However, low threshold temperatures are impractical in view of the noise level in the spectra and more importantly because of the blending of adjacent clouds which often occurs in crowded regions. We have found H\textsc{i} clouds or clumps using the automatic clump identification code with three thresholds of the brightness temperature, \(T_B = 16\) K (\(\approx 5 \times T_{\text{rms}}\)), 32 K, and 64 K. Final selection of the H\textsc{i} clouds has been made with

![Fig. 4.—H\textsc{i} column density image of the LMC from the combined ATCA and Parkes data. The intensity range is 0 to 6 \(\times 10^{21}\) H-atom cm\(^{-2}\) in H\textsc{i} column density. The peak H\textsc{i} column density is 8.8 \(\times 10^{21}\) cm\(^{-2}\) at R.A. 05h39m04s, decl. \(-69^\circ 14'01"\) (J2000).](image-url)
Fig. 5.—Declination velocity images of the LMC. Each panel is a slice through the LMC data cube at P.A. = 0° at the R.A. specified at the top of each panel. The R.A. separation of the slices is ~2°.0 or ~10 beamwidths, and the width of each slice is 23°, or ~2 beamwidths. Only a fraction of the data is shown. The gray scale intensity range is 0–136.7 K.
Fig. 5.—Continued
high-temperature thresholds in order to reduce the blending of emission from unrelated clouds.

The distribution by number of the H\textsubscript{i} clouds as a function of their size is presented in Figure 7. The derived sizes of clouds are distributed in a wide range of scales 20–400 pc. The sizes are computed as the square root of the area. The peak of their size distribution of H\textsubscript{i} clouds or clumps resides in 20–30 pc. However, the effective synthesis beam size limits the size distribution of the smallest H\textsubscript{i} clouds. The data are consistent with a power-law distribution with slope between $s = 1.47 \pm 0.2$ of a cloud boundary (Vogelaar & Wakker 1994; Williams, Blitz, & McKee 2000). The measured fractal dimension of H\textsubscript{i} clouds in the LMC is a similar dimension, $D = 1.4$, found in many studies of the molecular ISM (Falgarone et al. 1991; Williams, Blitz, & McKee 2000). For clouds identified with different thresholds of the brightness temperature, the fractal dimension $D$ found from the relation between area and perimeter is invariant, as shown in Figure 8.

We find that a previous analysis of the holes and shells in the H\textsubscript{i} distribution shows the same power-law behavior with that of clumps. The implication of the result is that the formation of the filament-like or shell-like structures, as well as clumps, could be formed with the same power law for dependence on the mass of gas in the galaxy and the stellar energy feedback. A satisfactory theoretical explanation needs to be developed for this observational fact.
Fig. 7.—Histograms of H i clump size for three thresholds of the brightness temperature, $T_B = 16, 32, \text{ and } 64 \text{ K}$

### TABLE 1

**List of Positions, Radii, and Heliocentric Velocities for the H i Supergiant Shells (SGSs) Identified in the LMC**

| Shell     | R.A. (J2000) | Decl. (J2000) | Shell Radius (arcmin) | Expanding Velocity (km s$^{-1}$) | Heliocentric Velocity (km s$^{-1}$) |
|-----------|--------------|---------------|-----------------------|-----------------------------------|-------------------------------------|
| SGS1      | 04 58 36     | −73 33 57     | 24.3 × 22.7           | 19.0                              | 253                                 |
| SGS2      | 04 58 30     | −68 39 29     | 18.7 × 18.7           | 17.0                              | 272                                 |
| SGS3      | 04 59 41     | −65 44 43     | 26.9 × 26.9           | 15.0                              | 294                                 |
| SGS4      | 05 02 51     | −70 33 15     | 36.7 × 28.3           | 23.0                              | 241                                 |
| SGS5      | 05 04 08     | −68 31 55     | 36.6 × 36.6           | 13.0                              | 292                                 |
| SGS6      | 05 13 58     | −65 23 27     | 49.0 × 37.5           | ...                               | 300                                 |
| SGS7      | 05 22 42     | −66 05 38     | 32.7 × 11.2           | ...                               | 305                                 |
| SGS8      | 05 23 05     | −68 42 49     | 15.0 × 15.0           | 22.5                              | 271                                 |
| SGS9      | 05 25 46     | −71 09 16     | 30.7 × 30.7           | ...                               | 235                                 |
| SGS10     | 05 30 45     | −68 04 30     | 32.7 × 26.5           | ...                               | 284                                 |
| SGS11     | 05 31 33     | −66 40 28     | 38.7 × 37.7           | 36.0                              | 306                                 |
| SGS12     | 05 30 26     | −69 07 56     | 41.1 × 29.0           | ...                               | 269                                 |
| SGS13     | 05 30 30     | −68 48 28     | 14.5 × 21.2           | ...                               | ...                                 |
| SGS14     | 05 34 33     | −66 20 15     | 15.4 × 15.4           | ...                               | 305                                 |
| SGS15     | 05 34 44     | −68 44 36     | 17.9 × 17.9           | 24.0                              | 279                                 |
| SGS16     | 05 36 54     | −68 27 46     | 15.3 × 15.3           | 18.0                              | 269                                 |
| SGS17     | 05 40 26     | −68 18 58     | 33.3 × 26.7           | ...                               | 292                                 |
| SGS18     | 05 41 00     | −71 15 18     | 30.0 × 26.7           | ...                               | 223                                 |
| SGS19     | 05 41 27     | −69 22 23     | 26.0 × 26.0           | ...                               | 259                                 |
| SGS20     | 05 46 49     | −70 02 32     | 24.7 × 24.7           | ...                               | 259                                 |
| SGS21     | 05 44 53     | −66 28 29     | 13.0 × 13.0           | 19.0                              | 299                                 |
| SGS22     | 05 46 16     | −68 22 02     | 14.7 × 14.7           | 21.5                              | 303                                 |
| SGS23     | 05 51 16     | −67 37 18     | 41.3 × 41.3           | 23.0                              | 296                                 |

*Note.*—Units of right ascension are hours, minutes, and seconds, and units of declination are degrees, arcminutes, and arcseconds.
5. SUMMARY

We present the merged images of the LMC from the H\textsc{i} Parkes multibeam observations with the aperture synthesis mosaic made by combining data from 1344 separate pointing centers using the Australia Telescope Compact Array (ATCA). The images are constructed by a Fourier-plane technique and sensitive to structure on scales of 15 pc (for an LMC distance of 55 kpc) upward. The addition of total power data reveals the plateau of diffuse H\textsc{i} emission. We find that total power data are important in recovering the true source structures; even the linear mosaicking technique recovers the "missing" short spacings in the uv plane (Ekers & Rots 1979; Cornwell 1988). The structure of the neutral atomic ISM in the LMC reveals the clumpiness of the H\textsc{i} distribution over the whole of the LMC. We have identified and cataloged H\textsc{i} clouds in the LMC by defining a cloud to be an object composed of all pixels in right ascension, declination, and velocity that are simply connected and that lie above the threshold brightness temperature. The power-law distribution of the size spectrum of H\textsc{i} clouds is similar to the typical size spectrum of the holes and shells in the H\textsc{i} distribution.

We are indebted to the other team members of the ATCA H\textsc{i} mosaic project, Mike Kesteven and Dave McConnell. We thank Bruce Elmegreen and Martin White for interesting discussions. We appreciate an anonymous referee for improvement of this paper. Y. L. is partially supported by Strategic National R&D Program (M1-0222-00-0005) from the Ministry of Science and Technology, Republic of Korea. S. K. is partially supported by NSF grant AST 01-00793.

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Fig. 8—Log-log plot of the measured perimeter vs. the measured area in units of pixels of H\textsc{i} clump for three thresholds of the brightness temperature, $T_B = 16, 32, \text{and } 64 \text{ K}$. 

T=16 K

log NP (Perimeter)

log NP (Area)

T=32 K

log NP (Perimeter)

log NP (Area)

T=64 K

log NP (Perimeter)

log NP (Area)
