A PRELIMINARY HI MASS FUNCTION FROM THE HIPASS SURVEY

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Abstract

The HIPASS survey is being conducted at using the multibeam receiver on the Parkes Telescope, Australia. It is a blind survey of the whole southern sky in neutral hydrogen and is currently about 25 % complete. We discuss a preliminary HI mass function that has been derived for the -74° declination band, an area which has been surveyed to the full sensitivity of the survey.

1 Introduction

The HI Parkes All Sky Survey (HIPASS) will survey the whole southern sky, as well as the southern part of the northern sky (Staveley-Smith et al 1996 [10]). A deeper survey of the Zone of Avoidance (ZOA) is being conducted concurrently. Surveys in HI that have been conducted in the past often concentrated on voids (eg Krumm & Brosch 1984 [5]) or clusters (eg Lo & Sargent 1979 [6]), and such surveys are not representative of the distribution of neutral hydrogen in the field. The two Australian surveys will allow us to study the distribution of HI in all environments. We also avoid the bias encountered when using optical catalogues to select galaxies for neutral hydrogen observations - such observations are biased towards galaxies with high optical surface brightness. Previous studies have shown that there is a trend towards increasing HI mass with decreasing optical luminosity (eg Staveley-Smith et al, 1992 [9], Bothun et al 1987 [4]), so blind HI surveys will provide a way of finding the objects that may have been missed in the optical surveys. A blind survey in neutral hydrogen also provides a method for finding blue compact dwarfs, which are hard to detect in the optical, but which may be detectable through their HI (Tyson & Scalo, 1988 [11]). The HIPASS survey will be able to provide information on the clustering of dwarf galaxies to determine whether they trace the luminous matter, or if they are less clustered and follow the large scale matter distribution.

2 The HIPASS Survey

The HIPASS survey is being conducted using the 13 beam multibeam receiver mounted on the Parkes 64m Radio Telescope in NSW, Australia. The beamwidth is 14.3 arcmin, and the spacing of the beams is about two beamwidths. The sky is actively scanned in declination strips and the total integration time on each beam area will be about 500 seconds. The theoretical HI mass limit for the survey is about $10^6 d^2 M_\odot$ (d = distance in Mpc), and the RMS noise expected for the data cubes is $\sim$ 10 mJy beam^{-1}. The velocity range that the HIPASS survey covers is from -1200km s^{-1} to 12700km s^{-1}, with a velocity resolution of 18km s^{-1}. The time-scale for completion is about three years. For further information on the multibeam system and data reduction strategies see Barnes et al (1998 [2]) and Barnes (1998 [3]).

2.1 The Status of the Survey so far

The region from Declination -90° to -54° has been observed at least once so far, with the total number of scans for the survey being five scans. The Centaurus A Group (Banks et al, 1998 [1]) and Sculptor Group, and the -74° declination band have all been surveyed to full sensitivity. Ongoing follow-up observations are being made at the Australia Telescope Compact Array (ATCA) and optical follow-up observations are taking place at the Siding Spring and CTIO 40 inch telescopes. These observations provide greater positional accuracy for the HI detections, and corresponding deep optical observations where no optical counterpart is obvious in existing databases.

3 The -74° region and a Preliminary HI Mass Function

This region consists of a 8° wide strip at declination -74° which covers the full range in Right Ascension. The area of the region is $\Omega = 0.242$ steradians, and 118 galaxies were detected after visual inspection of the region. Of these, 16 have no previous optical identification, and 42 have no previous redshift information. About 50 % of the detections are new observations in HI. As yet, no isolated clouds of HI without optical counterparts have been detected, but a few candidates are still awaiting optical observations.

A sample of galaxies was selected from the $-74°$ region to calculate the preliminary mass function. The criteria for selection was an integrated flux cut-off of 4 Jy km s^{-1} and no confusion with nearby sources. With this selection criteria, 99 galaxies remained in the sample. This number is already represents the largest sample of HI selected galaxies, the next biggest being the Arecibo Strip Survey with 66 galaxies (Zwaan et al, 1997 [12]). A histogram showing the distribution of velocities of the objects is shown in Figure 1(a). The sample is flux limited within this velocity range. The mass distribution for the sample can be seen in Figure 1(b). This histogram shows that there are few galaxies in the low mass bins, most likely due to the integrated flux cut-off imposed for completeness.

The HI mass function was computed using the flux limited sample of 99 galaxies (see Figure 2). The $\sum(1/V_{max})$ method was used (Schmidt, 1968 [8]), with an H_o value of 100km s^{-1} Mpc^{-1}. A Schechter function (Schechter, 1976 [7]) was fitted to the data by eye, and the best fit was found with a characteristic mass of $M^* = 9.5$, a low mass slope of $\alpha = -1.35$ and normalization of $\theta = 0.014$. The faint end slope of this function is similar to the result from Zwaan et al (1997 [12]), who obtain a faint end slope of $\alpha = -1.20$. The low mass end of the HI mass function is interesting, as it tells us if dwarf galaxies contain most of the neutral hydrogen in the universe, or if it is found in the larger galaxies. The faint end of the HI mass function

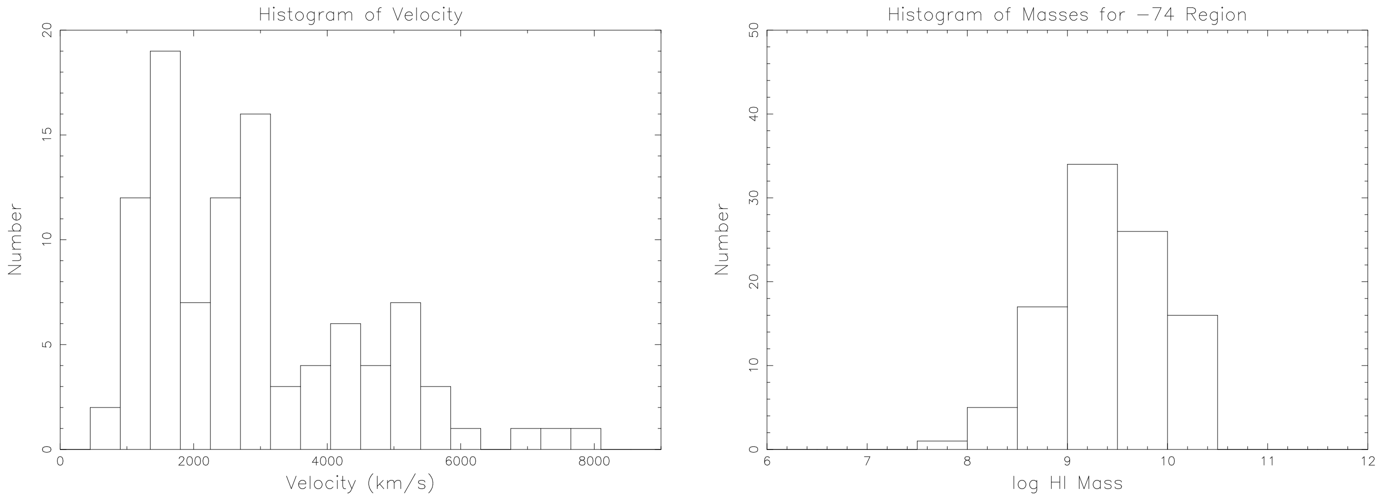

Figure 1: Distribution of Masses and Velocities of galaxies in the -74° Region

is poorly known, as most published surveys of HI masses of galaxies have been selected from optical catalogues.

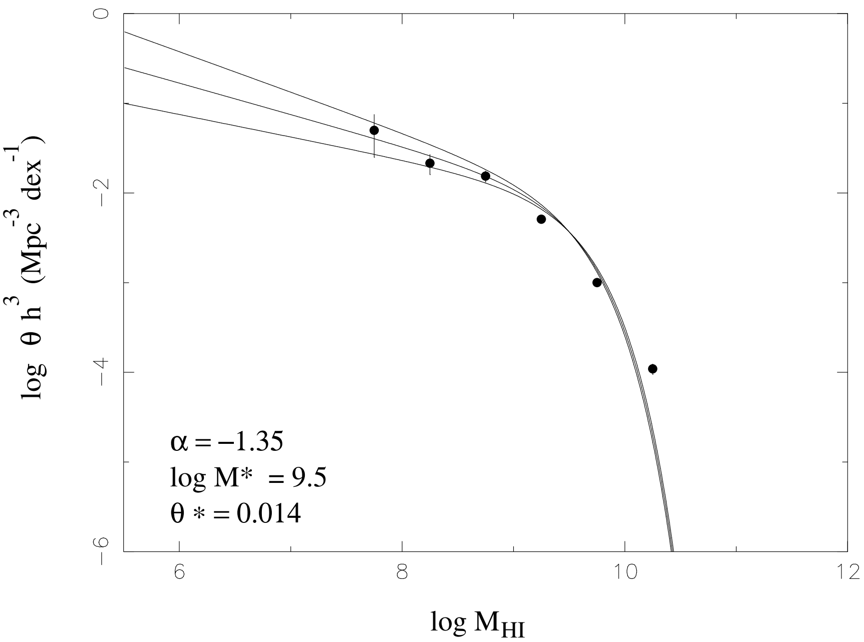

Figure 2: The HI Mass function for the -74° region. The slopes are for α = -1.25, -1.35, -1.45.

3.1 Survey Volume

The volume surveyed for the -74° region is shown in Figure 3. This volume has been calculated using an integrated flux cut-off of 4 Jy km s^{-1} for the upper line, and 2 Jy km s^{-1} for the lower line. We can see if we use automatic detection algorithms and are able to get a complete sample at a cut-off of 2 Jy km s^{-1}, the sample in the low mass end will increase, while the sample at the high mass end will stay the same. This means that we will improve the measurement of the slope at the low mass end of the HI mass function as we decrease the flux cut-off.

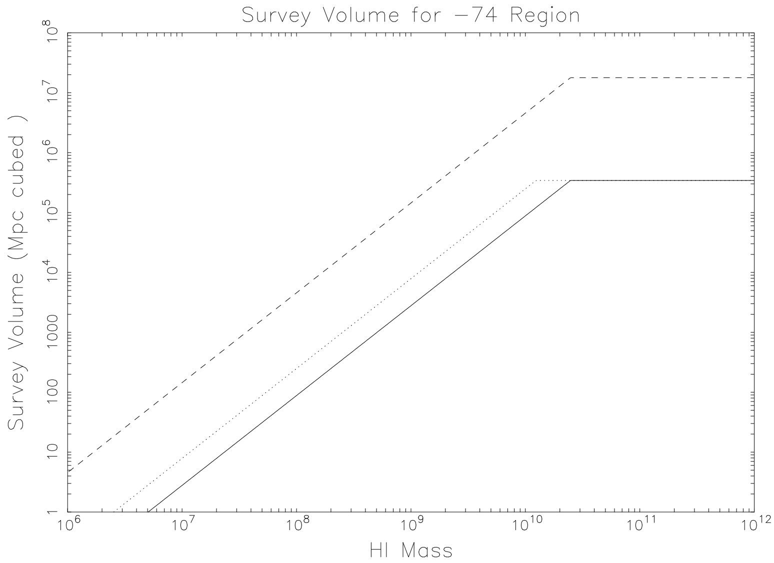

Figure 3: Survey Volume for the HIPASS survey (dashed line) and the -74° region (solid line for integrated flux cut-off of 4 Jy km s^{-1} and dotted line for integrated flux cut-off of 2Jy km s^{-1})

4 Conclusion

The HIPASS survey will improve the sample of HI selected galaxies by several orders of magnitude. The results of the 4% mass function show a low mass end slope of -1.35, which is similar to values found in other blind surveys so far.

5 Acknowledgements

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