During our survey of the Fornax cluster, a nearby large and bright galaxy, NGC 1365, was detected in two separate pointings of the single beam system. Essentially, one pointing happened to be towards the side of the galaxy rotating towards us, and the other pointing was towards the side of the galaxy rotating away from us, resulting in detections which differed by ~ 90 km s^{-1}. The survey and reduction technique for the All Sky Survey will need to correctly match signals in nearby beams, and indeed should be capable of mapping at moderate resolution such nearby, bright galaxies.

Acknowledgments

I thank Jason Contarini, Anthony Howes, Virginia Kilborn, Margaret Mazzolini, Lister Staveley-Smith, Euan Troup, Wilfred Walsh, Rachel Webster, Warwick Wilson and Alan Wright for help with observations; and Lister Staveley-Smith and Rachel Webster for valuable discussions related to this survey. This research has made use of the NASA/IPAC Extragalactic Database (NED) which is operated by the Jet Propulsion Laboratory, Caltech, under contract with the National Aeronautics and Space Administration. This research has also made use of the Digitised Sky Survey (DSS) provided by the Space Telescope Science Institute, based on photgraphic data from the UK Schmidt Telescope. I acknowledge the support of an Australian Postgraduate Award.

Briggs, F. H. 1990, AJ, 100, 999
Fisher, J. R., & Tully, R. B. 1981, ApJ, 243, L23
Giovanelli, R., & Haynes, M. P. 1989, ApJ, 346, L5
Hoffman, G. L., Lu, N. Y., & Salpeter, E. E. 1992, AJ, 104, 2086
Krumm, N., & Brosch, N. 1984, AJ, 89, 1461
Schneider, S. 1985, ApJ, 288, L33
Shostak, G. S. 1977, A & A, 54, 919
Szomoru, A., van Gorkom, J. H., Gregg, M., & de Jong R. 1993, AJ, 105, 464

Galactic H I Mapping and Optical–IR Studies

R. D. Davies

Nuffield Radio Astronomy Laboratories,
University of Manchester, Jodrell Bank,
Macclesfield, Cheshire, SK11 9DL, UK.
rdd@jb.man.ac.uk

Abstract: H I structure is seen at every scale down to the angular resolution limit of all survey telescopes. I present several examples of the structures at high Galactic latitudes with the 12 arcmin beam of the Lovell Telescope, the 2 arcmin resolution of the DRAO synthesis, as well as other indicators of finer scale structure in the interstellar medium (ISM).

1 Introduction

The current widely used all-sky or large-area surveys of the Galactic H I distribution are the Bell Telephone $2^\circ \cdot 5$ resolution survey (Stark et al. 1992) and those at $0^\circ \cdot 6$ using the 25-m telescopes (Weaver & Williams 1973; Heiles & Habing 1974; Hartmann & Burton 1996). These surveys have been used for many purposes including, for example, the calculation of Galactic optical absorption, comparison with IRAS IR distributions and studies of the intermediate scale ISM structure. The benefit of a higher resolution large-area survey at $12'$, as would be produced by the Lovell Telescope at Jodrell Bank using the multibeam system, would be immense. This paper describes some programmes of H I observations at this resolution which address a variety of astrophysical issues.

2 H I-IRAS Comparisons at 12 arcmin Scales

The 60μ and 100μ brightnesses measured by IRAS are known to correlate well with the Galactic H I surface density. However, this correlation is not perfect and reflects a range of physical conditions in the ISM which we have investigated by studying well-defined 100μ clouds at high Galactic latitudes with 100μ surface brightness in the range $0 \cdot 5$ to 5 mJy sr^{-1}. By using adjacent off-cloud references it is possible to establish accurately the ratio of far-infared to neutral hydrogen surface density I_{100}/N(H I) without dependence on the unknown FIR zero level. The individual FIR clouds were directly indentifiable in H I and each has its particular velocity (Malawi & Davies 1996). When the data from the independent observed points in all 12 observed clouds were plotted in the I_{60}/I_{100} vs I_{100}/N(H I) plane, a significant scatter was found. This scatter suggests that the clouds are subject to different interstellar radiation fields and that they consist of different mixes of dust grain sizes. The influence of the radiation field can be seen in the factor 2 difference in I_{100}/N(H I) between the Northern and Southern Galactic pole regions in the sense expected from the Sun's 20 pc offset from the mid-layer of the Galactic disk. Further, no difference was found between the FIR-H I properties of low velocity Galactic disk gas and intermediate velocity clouds (IVCs) at $v(\mathrm{lsr}) \sim -40$ km s^{-1}. It should also be emphasised that stray-radiation corrections are essential in any such intermediate and high latitude studies.

A survey by Willacy et al. (1993) of a $6^\circ \times 2^\circ$ field in the low H I surface brightness region centred on RA $= 10^h07^m$, Dec $= 53^\circ$ has been made with the $12'$ beam of the Lovell Telescope. This map of H I surface brightness was used in a study of the soft X-ray distribution from ROSAT. Again H I features were found on all scales down to the resolution limit of $12'$

3 Interstellar Medium Physics

The Queen's University Belfast–Jodrell Bank optical–IR programme addresses questions about physical conditions in the ISM. H I emission data are taken along lines of sight to stars whose absorption spectra are of particular interest, for example lying in the direction of intermediate velocity clouds (IVCs) or high velocity clouds (HVCs). The -71 km s^{-1} IVC/HVC lying in front of the globular cluster M13 has been investigated in this way using Echelle spectra from the Na I D line and Ca II K line observations of stars in M13 along with 12′ resolution H I spectra taken with the Lovell Telescope (Shaw et al. 1996). N(Na I)/N(H I) ratios in the clouds lying in front of M13 lie in the range $1\text{–}4 \times 10^{-8}$, while the N(Ca II)/N(H I) ratios are $\geq 10^{-7}$. Temperatures in the compact clouds are a few hundred Kelvin while the warmer, more extensive, gas is at $\sim 10^4$ K. Ionisation conditions can be determined for the clouds.

Similar investigations have been made of the conditions in the large gas concentration (1300 $M_\odot$), in the direction of Perseus at $l = 150°$, $b = -10°$ (Trapero et al. 1995). H I temperatures in this cloud reach as low as 30 K. Systematic velocity changes across its surface of several km s^{-1} are found. A distance for the cloud of ∼100 pc was determined from the presence or not of corresponding absorption features in the spectra of stars lying this direction.

4 Angular Structure in H I

Structure in Galactic H I is found on all scales accessible to observation. A good example of this range of structure may be found in the study of the M13 region by Shaw et al. (1996). Features are seen with the Lovell Telescope on scales of 12 arcmin and greater. Observations at 2 arcmin resolution with the DRAO Synthesis Telescope show structure on that scale while optical evidence from Na I and Ca II spectra, and by implication H I, indicates significant differences in the line of sight to stars ∼ 10 arcsec apart. This interstellar material is believed to be at a distance of ∼ 100 pc where 1 arcmin corresponds to 0·03 pc.

Radio interferometer data on H I clouds seen in absorption against extragalactic radio sources show structure down to 0·1 arcsec. Davis, Diamond & Goss (1996) find 10–30% changes in optical depth over 0·1 arcsec in galactic H I lying in front of the sources 3C138 and 3C147.

5 Conclusions

The evidence presented above shows that Galactic H I occurs on all angular scales down to arcseconds. An all-sky survey of H I at an angular scale of ∼10 arcmin would provide a rich source of data for many current areas of interest. These include the distribution and kinematics of H I in the Galactic disk, the structure of the nearby ISM from studies of intermediate and high latitude H I, HVCs and IVCs as well as tidal tails of our own Galaxy and the Magellanic Clouds. The imminent availability of multibeam systems for H I observations makes such large-area surveys a realistic possibility.

The Jodrell Bank multibeam system at present under construction consists of four dual–polarised horns at the prime focus of the Lovell Telescope. Each of the eight receiver systems will operate with a system noise of 25 K and feed into a 1024 channel two-level correlator spectrometer. The system will be used for Galactic and extragalactic studies.

Davis, R. J., Diamond, P. J., & Goss, W. M. 1996, MNRAS, in press
Hartmann, D., & Burton, W. B. 1996, An Atlas of Galactic Neutral Hydrogen Emission (Cambridge University Press), in press
Heiles, & C., Habing, H. J. 1974, ApJ Suppl., 14, 1
Malawi, A., & Davis, R. D. 1996, in preparation
Shaw, C. R., Bates, B., Kemp, S. N., Keenan, F. F., Davies, R. D., & Roger, R. S., 1996, ApJ, in press
Stark, A. A., et al. 1992, ApJ Suppl., 79, 77
Trapero, J., Beckman, J. E., Serra-Rickart, M., Davies, R. D., Watson, R. A., & Garcia Lopez, R. J. 1995, ApJ, 445, 231
Weaver, H. F., & Williams, D. R. 1973, ApJ Suppl., 8, 1
Willacy, K., Pedlar, A., & Berry, D. 1993, MNRAS, 261, 165

An H I Mosaic of the Large Magellanic Cloud

Sungeun Kim and K. C. Freeman

Mount Stromlo & Siding Spring Observatories,
Private Bag, Weston ACT 2611, Australia.
sek@mso.anu.edu.au

L. Staveley-Smith, R. J. Sault, M. J. Kesteven and D. McConnell

Australia Telescope National Facility, CSIRO,
PO Box 76, Epping, NSW 2121, Australia.

Abstract: The parameters of a new Australia Telescope Compact Array (ATCA) mosaic of the Large Magellanic Cloud (LMC) in the 21-cm line of neutral hydrogen are described. A preliminary peak-brightness-temperature image of the whole of the LMC, and a detailed image of the region around the supergiant shells LMC 4 and 5 is shown.

1 Introduction

The LMC is the nearest internally bound galaxy to the Milky Way, and is an important laboratory for the study of gas dynamics and star formation in young galaxies. Previous H I observations (e.g. Luks & Rohlfs 1992) have been limited by the spatial resolution of the Parkes telescope at 21 cm (220 pc at the distance of the LMC). However, the ATCA permits much higher spatial resolution to be