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HI Observations of Southern LSB Dwarf Galaxies from the Karachentsev Catalogue

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Abstract: In this paper, we report on HI observations of newly detected nearby dwarf galaxies from the first part of the Karachentsev catalogue which contains low surface brightness galaxies spotted on the POSS II. We performed HI observations of 220 galaxies using the 100-m radio telescope at Effelsberg, the Nançay radio telescope, and the Australia Telescope Compact Array. We discuss global parameters of the whole sample and the observations of the southern sample in more detail. Global parameters of the observed galaxies are as expected from the sample of nearby galaxies (Kraan-Korteweg & Tammann 1979). The increase of the number of known galaxies in the Local Volume (i.e. within a distance of 10 Mpc) could be as high as 20% for the whole sky.

Keywords: surveys — galaxies: distances and redshifts — galaxies: irregular — radio lines: galaxies

1 Introduction

Catalogues of the Local Volume (LV) (i.e. of galaxies within 10 Mpc) obviously are highly incomplete for at least two reasons; firstly, the 'zone of avoidance' with its extinction of several magnitudes in the optical light hides many galaxies and, secondly, studies of the LV always need an all-sky coverage which will be nearly always sensitivity limited. There are different ways to improve the degree of completeness of the nearby galaxy sample, e.g. a deep all-sky optical survey like the Second Palomar Sky Survey (POSS II) or an all-sky 'blind' survey in the 21-cm line of neutral atomic hydrogen like HIPASS (HI- Parkes Sky Survey).

Karachentseva & Karachentsev (1998) published the first part of their search for candidates of nearby dwarf galaxies, a result of searching POSS II and ESO/SERC films by eye and magnifying glass for faint objects with a diameter limit of $0{\cdot}5'$. They found 245 galaxies within a region defined by the nearby galaxy groups within the Local Volume. The area covered in this search corresponds to about 25% of the sky. A total of 139 of the galaxies in their list were not catalogued before. Most of the listed galaxies are low surface brightness objects. Here we are reporting on results which are based only on the first part of the Karachentsev catalogue. Work on the second part is in progress.

2 Observations

We performed HI observations of 220 galaxies from the Karachentsev catalogue using three different radio telescopes in order to achieve an all-sky coverage. Galaxies north of declination $-30°$ have been observed using the 100-m radio telescope at Effelsberg [half power beamwidth (HPBW) of $9{\cdot}3'$], and galaxies in between $-30°$ and $-38°$ have been observed with the Nançay radio telescope (HPBW of $3{\cdot}6'\times22'$ in R.A. and Dec. respectively). For the single dish observations a velocity coverage of 4400 $\mathrm{km\,s^{-1}}$ and a channel separation of $5\,\mathrm{km\,s^{-1}}$ was achieved.

Forty galaxies south of declination $-38°$ have been observed with the Australia Telecope Compact Array in a snapshot mode (with the 750A configuration) resulting in a synthesised beam of about $1'$, a velocity coverage of about 3000 $\mathrm{km\,s^{-1}}$ and a channel separation of $6{\cdot}6\,\mathrm{km\,s^{-1}}$. Each galaxy was observed five to six times for 10 minutes at intervals of a few hours in order to achieve a decent coverage of the UV plane. In Figure 1 we display the global HI profiles of the 17 detected galaxies from our southern sample.

A pilot project with northern single-dish observations was published recently (Huchtmeier, Karachentsev & Karachentseva 1997).

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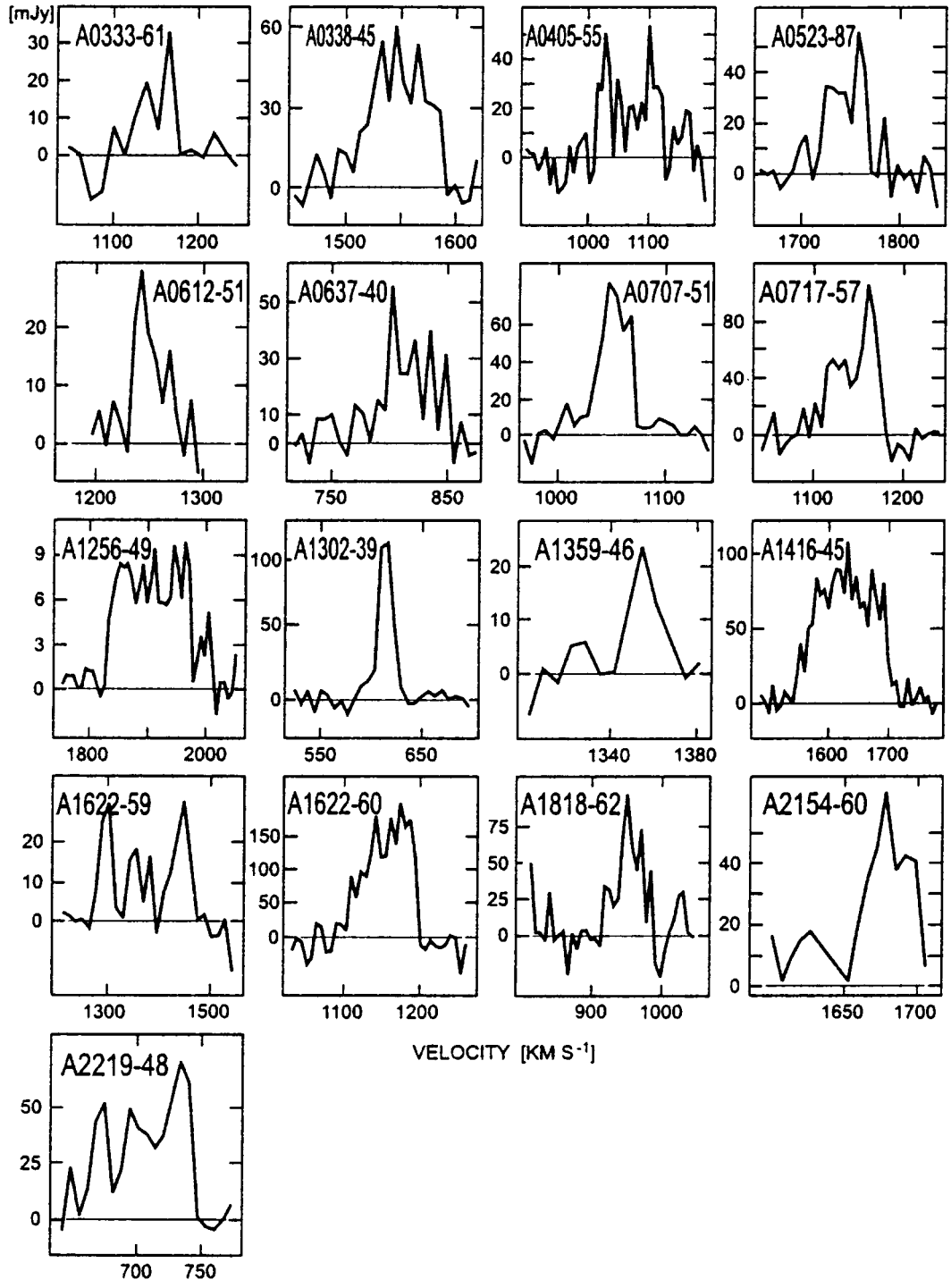

Figure 1—Global HI profiles of the 17 galaxies detected with the compact array of the ATNF. Profiles as narrow as 13·5 km s^{-1} (A1302−39) and as wide as 176 km s^{-1} (ESO 137−G270) are found.

3 Discussion

Most of the observed HI profiles (of the whole sample) are narrow (13·5 km s^{-1} for the narrowest line) which is typical for dwarf galaxies (slow rotation). From the distribution of radial velocities of the detected galaxies within our sample we derive that most of these galaxies are within the Local Supercluster, and about 25% of the detected galaxies are within the Local Volume. There are only a few low surface brightness (LSB) background objects. Typical global values for the galaxies in the Local Volume are fainter or equal to an absolute B magnitude of −15, linear diameter of 1·5 kpc, average HI mass of $5\times10^7 M_\odot$, and a total mass of $6\times10^8 M_\odot$ (the typical corrected linewidth being of the order of 50 km s^{-1}).

The correlation between linear optical diameter in kpc (at the D_{25} level, see de Vaucouleurs, de

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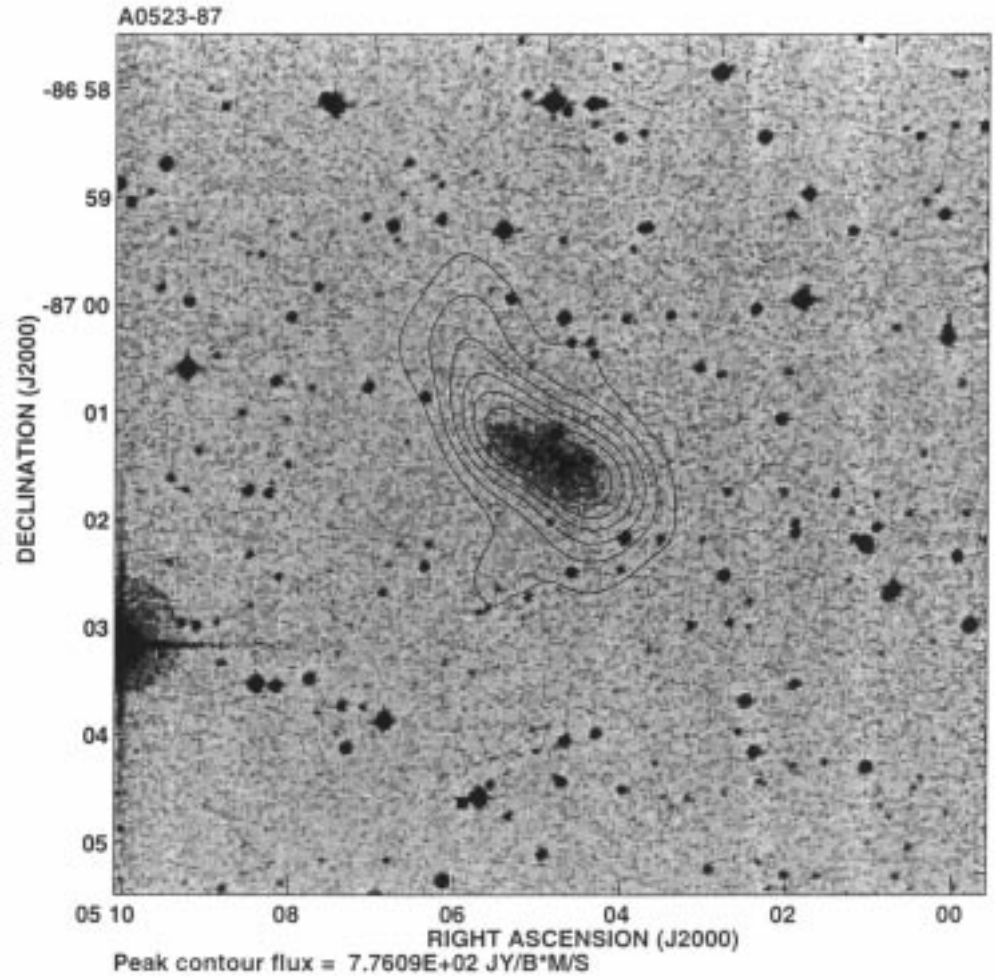

Figure 2—A digital sky survey image of the galaxy A0523−87 with contours of the HI distribution. Contour levels are in steps of 10% of the peak (which corresponds to a column density of 6×10^{20} cm^{-2} of HI atoms), the lowest contour corresponds to 30% of the peak value. This galaxy is typical for our sample as it shows a low surface brightness with the HI distribution definitely larger in extent than the optical counterpart. Often there are asymmetric features seen in lower contour levels of the HI distribution.

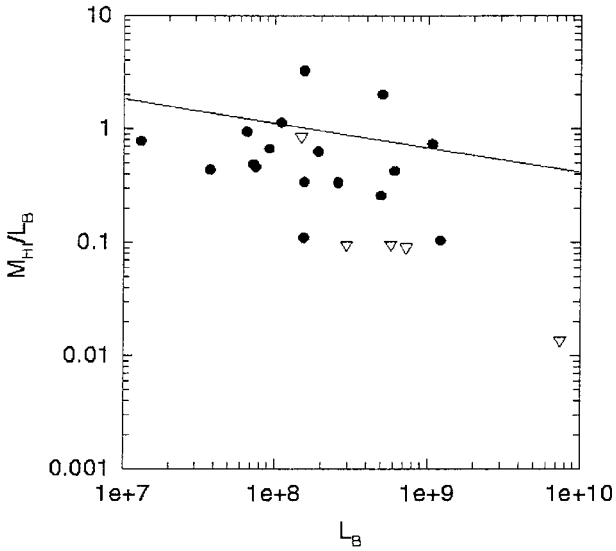

Figure 3—The $M_{\rm HI}/L_{\rm B}$ ratio for the detected galaxies (filled circles) plotted versus blue luminosity L_B. Upper limits are shown for five undetected galaxies with known redshifts (triangles).

Vaucouleurs & Corwin 1976) and the total HI mass for the whole sample is the same as observed for the Kraan-Korteweg–Tammann (1979) sample for the HI observations (see e.g. Huchtmeier & Richter 1988). The same is true for the correlation between HI mass and total mass.

In nearly all cases the HI distribution is centred on the optical position of the galaxy. However, lower contours of the HI distribution often show asymmetric shapes (see Figure 2) and two galaxies are definitely disturbed in the HI distribution and/or the velocity field. On average the HI distribution is larger than the optical extent (D_{25}) by a factor of 3.

The ratio of the total HI mass to blue luminosity M_{HI}/L_B often is taken as a measure of the relative HI content. In Figure 3 the M_{HI}/L_B ratio is plotted versus optical blue luminosity L_B. The line represents the relation found for the sample of nearby galaxies (e.g. Huchtmeier & Richter 1988). Part of the scatter might be due to uncertainties in the observable quantities, in many cases blue

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magnitudes are precise to 0·5 magnitude only. For the upper limits 1 Jy km s^{-1} was assumed in all cases. This does change with the noise and the assumed line width (i.e. rotational velocity) of the undetected galaxies; r.m.s. errors correspond to about five times the size of the symbols in Figure 3. In addition to this we may miss some flux with the interferometer (missing flux) as the observed HI emission extends over more than 2′ per channel for over 60% of the galaxies. In general the deduced values of M_{HI}/L_B seem to be lower than expected from the comparison sample by a factor of 2. However, in view of the error discussion above more precise optical magnitudes are needed. Therefore, we recently started an observational project to obtain multicolour photometry in order to improve the total magnitudes and to investigate the light distribution of these low surface brightness galaxies. In the work of Mathewson, Gallagher & Littleton (1995) on single-dish observations of late-type galaxies two of our objects are included, AM0637−404 and AM1013−394. For AM0637−404 they detected a narrow emission line at 272 km s^{-1}, classified as a galactic HVC, and an emission line at 821 km s^{-1} in good agreement with our velocity measurement of 824 km s^{-1}. Their HI flux for this galaxy is twice as high as our value, a possible hint that we might miss some of the HI flux.

The upper limits of M_{HI}/L_B in Figure 3 are more or less close to our sensitivity limit except one very low value which corresponds to AM1012−443. There is an HI detection for AM1013−394 at a radial velocity of 263 km s^{-1} (Mathewson, Gallagher & Littleton 1995) with a flux of 2 Jy km s^{-1} which we probably did not see due to our sensitivity limit. Their other HI line for this source has a radial velocity of 2982 km s^{-1} which happened to lie at the edge of the bandpass of our observations and was not further considered.

Since the first compilation of galaxies in the LV in 1979 by Kraan-Korteweg and Tammann the number of known galaxies increased from 179 to 303 galaxies (Karachentsev 1998, personal communication). This search for nearby dwarf galaxies—the first part of which is presented here—is expected to further increase this number.

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