Abstract
We present the results of our HI survey of six loose groups of galaxies analogous to the Local Group. The survey was conducted using the Parkes telescope and the Australia Telescope Compact Array to produce a census of all the gas-rich galaxies and analogs to the high-velocity clouds (HVCs) within these groups down to $M_{HI} < 10^7 M_\odot$ as a test of models of galaxy formation. We present the HI mass function and halo mass function of the loose groups and show that they are consistent with those of the Local Group. We discuss the possible role of HVCs in solving the “missing satellite” problem and discuss the implications of our observations for models of galaxy formation.

1. Introduction
The majority of “island universes”, 60%, reside in galaxy groups (Tully 1987), including the Milky Way. Loose groups of galaxies, like our Local Group, are collections of a few large, bright galaxies and tens of smaller, fainter galaxies. The large galaxies are typically separated by a few hundred kiloparsecs from each other and spread over an extent of approximately a megaparsec. They represent the most diffuse components of large scale structure and a labo-
ratory for studying galaxy formation. Loose groups are almost certainly still in
the process of collapsing (Zabludoff & Mulchaey 1998) and they may also con-
tain the gaseous remnants of galaxy formation in the form of the high-velocity
clouds (HVCs; Blitz et al. 1999). They also illustrate one of the major chal-
 lenges to current models of cold dark matter (CDM) galaxy formation. CDM
models predict that the Local Group should contain $300$ low mass dark ha-
los, while there are only $20$ luminous dwarf galaxies known. While this may
imply that we lack a complete census of the luminous galaxies in the Local
Group, it may also be uniquely deficient in dwarf galaxies. Or, perhaps, the
HVCs may populate these dark matter halos and solve the “missing satellite”
problem. In order to address this question and to better understand the prop-
erties of loose groups, we have conducted an $\text{H I}$ survey of six groups analogous
to the Local Group.

2. Observations

We selected our groups from the optical catalog of Garcia (1993). The re-
sulting groups are between 10.6 and 13.4 Mpc distant, contain between 3-9
bright galaxies which are separated, on average, by $550$ kpc, and have diam-
eters of $1.6$ Mpc. Their masses, as estimated by the virial theorem and the
projected mass estimator (Heisler et al. 1985), of $10^{11.7} - 13^{2} M$ are compa-
rable to the mass of the Local Group $10^{12.8} M$ (Courteau & van den Bergh
1999).

We used the Parkes Multibeam and Australia Telescope Compact Array
(ATCA) to survey the entire area of each group down to a $\text{H I}$ sensitivity of
$5\,\text{8}\,10^{5} M$ per $3.3$ km s$^{-1}$. All Parkes detections in the groups were con-
firmed to be real by the follow-up ATCA observations. A total of $64$ $\text{H I}$-rich
galaxies were detected in the six groups, almost twice the number of optically
cataloged group galaxies (Garcia 1993) and $50\%$ more galaxies than were de-
tected by HIPASS in the same fields (Meyer et al. 2004). All of our detections
are associated with optical counterparts and have properties consistent with
typical spiral, irregular, or dwarf irregular galaxies. No analogs to the HVCs
were detected. Examples of two typical new detections are shown in Figures 1.

3. Is the Local Group missing dwarf galaxies?

We wish to know if our sample of loose groups has a significantly different
population of dwarf galaxies as compared to the Local Group in order to deter-
mine if the Local Group is unique in some fashion. To do this we constructed
an $\text{H I}$ mass function ($\text{H I}$ IMF) and a cumulative circular velocity distribution
function (CVDF), both shown in Figure 2. The CVDF is an effective surrogate
for a halo mass function as traced by luminous matter. After correcting for the
incompleteness of our survey, using both the detection rate of fake sources in-
Figure 1. An overlay of the H I total intensity contours on the optical images of LGG 93-1 (left) and LGG 93-2 (right) also known as AM 0311-492 and LSBG F200-023, respectively. The ATCA beam is indicated by the hatched oval in the lower left of both images.

serted into our data and by scaling the HIPASS completeness function (Zwaan et al. 2004) to our survey parameters, we derive a flat H I MF as shown on the left panel of Figure 2 similar to that for the Local Group. This result is consistent with the results for the H I MF presented by Zwaan et al. (2005), who find the H I MF flattens in low density environments and the results of Tully et al. (2002) who find a similar behavior for the optical luminosity function. Similarly, the six loose groups have an identical CVDF to the Local Group with both falling below the predictions of CDM around $V_{circ} \approx 50 \text{ km s}^{-1}$. This demonstrates that the lack of a large population of dwarf galaxies is not unique to the Local Group.

4. Are the High-Velocity Clouds the “missing satellites”?

Blitz et al. (1999) and Braun & Burton (1999) suggested that the HVCs seen around the Milky Way may be embedded within the low mass dark matter halos that are predicted by CDM models of galaxy formation. Our non-detection of any HVC analogs in these six loose groups suggests that if this is the case, then they must be relatively low mass H I clouds, $M_{HI} \leq 10^5 \text{ M}_\odot$, and be within 150 kpc of the Milky Way (Pisano et al. 2004). These constraints are consistent with limits found by others through a variety of methods (e.g. Zwaan 2001, de Heij et al. 2002), but does not necessarily imply that HVCs are associated with the CDM dark matter halos (e.g. Maller & Bullock 2004). Deeper H I surveys of individual galaxies are still necessary to better constrain the nature and origin of HVCs.
Figure 2. Left: The HI mass function (HI MF) of the Local Group (circles) and the sum of the six loose groups (solid histogram) corrected for incompleteness (squares). Right: The cumulative velocity distribution function for the Local Group (circles), and the average of the six loose groups (squares). The solid line represents the CDM model of Klypin roughly normalized to the second data point.

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