The Local Volume HI Survey (LVHIS)

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The 'Local Volume' — the sphere of radius ∼10 Mpc centered on the Local Group — includes at least 500 known galaxies. What makes this volume special is the fact that we can obtain (a) accurate velocities and independent distances for all its member galaxies, (b) the most detailed and sensitive multi-frequency observations, and (c), as a result, a complete census of the Local Volume (LV) galaxies and their properties. This allows us to create a dynamic 3D view of the Local Universe, leading to a thorough understanding of the local flow field, ie. the Hubble flow and its dispersion. Interferometric H I measurements in particular provide a greater understanding of the overall matter distribution (baryonic and non-baryonic) in the Local Volume and are crucial to accurately define the low-mass end of the H I mass function.

Reliable, independent distance estimates for LV galaxies are being gathered either from the luminosity of Cepheids, the tip of the red giant branch, or surface brightness fluctuations. These are listed in *'A Catalog of Neighboring Galaxies'* (Karachentsev et al. 2004, AJ 127, 2031) together with the optical and H I properties of 451 LV galaxies. To expand and deepen our knowledge of the nearby Universe several teams are currently targeting LV galaxies, among them the *"Local Volume HI Survey"* (LVHIS; Koribalski et al.), the *"Faint Irregular Galaxies GMRT Survey"* (FIGGS; Begum et al.), *"The HI Nearby Galaxy Survey"* (THINGS; Walter et al.), and the *"VLA-ANGST HI Survey"* (Ott et al.).

Using the Australia Telescope Compact Array (ATCA), the LVHIS team[1] is producing detailed H I distributions, mean H I velocity fields and 20-cm radio continuum maps for a complete sample of more than 70 southern galaxies selected from HIPASS (see, eg., Koribalski et al. 2004, AJ 128, 16). Each galaxy is typically observed for 3×12 hours total, using different array configurations, to achieve good *uv*-coverage (out to 1.5 km baselines), medium

[1]The LVHIS team members are: Bärbel Koribalski (PI), Lister Staveley-Smith, Erwin de Blok, Jürgen Ott, Helmut Jerjen, Igor Karachentsev, Angel Lopez-Sanchez, Emma Kirby, Nic Bonne and Janine van Eymeren.

resolution and high sensitivity. The low-resolution ATCA observations are complete and the results, in particular the H I moment maps of all observed galaxies, are displayed on the web at www.atnf.csiro.au/research/LVHIS. — Complementary projects include an H-band survey of all southern LV galaxies with the Anglo-Australian Telescope (AAT) and an Hα survey with the ANU 2.3-m telescope. — The LVHIS project goals are:

(1) Investigation of **local galaxy environments**: Using H I synthesis observations we trace the faint outer envelopes of the known LV galaxies (see Fig. 1) as well as detect their low-mass companions down to H I mass limits of $\sim 10^4 \times D^2$ M$_\odot$. We are also searching for neutral gas that is not taking part in the regular galaxy rotation, e.g. high velocity clouds and tidal streams. So far, only a few previously uncatalogued galaxies have been found while asymmetric gas envelopes are common. Several result have been shown in Koribalski (2006, ESO Workshop on "Groups of Galaxies in the Nearby Universe", Springer, p. 27).

(2) Determination and analysis of H I **rotation curves**: These will allow us to estimate the total mass and therefore the dark matter content of individual LV galaxies and trace virtually all of the galactic dark matter in the Local Volume. We will take into account the influence of non-circular motions on the shape of rotation curves and explore a variety of models that optimally fit the best-determined curves.

(3) Determination of the true **Tully-Fisher** (TF) relation (incl. the baryonic TF): This will be achieved using independent distances, well- determined H I rotational velocities and (c) a homogeneous set of optical & infrared magnitudes. The sensitive H I velocity fields obtained in the LVHIS project are currently being used by Nic Bonne (ANU, PhD student) to determine galaxy rotation curves, $v(r)$, inclination angles, $i(r)$, and position angles, $PA(r)$, while Emma Kirby (ANU, PhD student) is analysing the deep AAT H-band images so far obtained for 55 LV galaxies.

(4) Determination of the H I **mass function** for the Local Volume: by obtaining accurate H I masses for a complete sample of nearby galaxies with well established distances, we can significantly improve our knowledge of the faint end of the H I mass function.

(5) Estimate of accurate **star formation rates** (or upper limits) for the sample from the 20-cm radio continuum flux density to equally faint limits ($\sim 2 \times 10^{-5} D^2$ M$_\odot$ yr^{-1}). These will be compared to SFR estimates obtained from SINGS (Kennicutt et al. 2003) and enable us to investigate on which scales the radio-infrared correlation breaks down. We will be able to estimate

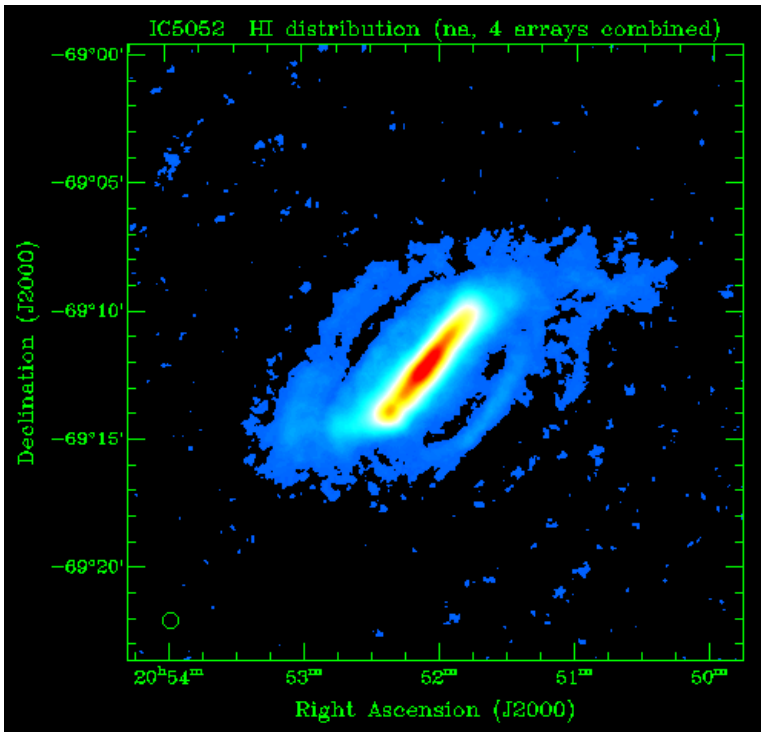

Figure 1: ATCA H I distribution of the nearby spiral galaxy IC 5052. While optical and infrared images of IC 5052 (type SBd) show a rather flat, edge-on galaxy, the observed H I envelope indicates an extended and highly warped gaseous disk.

the overall SFR density at $z = 0$ and compare with values measured at other wavelengths.

ATCA observations for the *"Local Volume HI Survey"* (LVHIS) will be completed in about a year, but further observations with the GMRT, WSRT and the eVLA are needed to complete the census of Local Volume galaxies. All-sky and deep H I surveys planned with the Australian SKA Pathfinder, a large interferometer to be located in Western Australia, will provide the next step in our understanding of the Universe.