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PRESENTACIÓN MURAL

A kinematic study of three HI-rich local galaxies

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Abstract. The "Local Volume H I Survey" is a large project aimed at studying nearby galaxies, at very high angular resolution and sensitivity, supplemented with multi-frequency data. In this paper we present comparative results of the dynamics and morphology of three LVHIS galaxies. For each source we derived physical and geometrical parameters (inclination, H I total mass, star forming rate, mass-to-light ratio, etc). We determined the global material distribution and the velocity field. Finally, we discuss the results obtained.

Resumen. El relevamiento denominado "Local Volume H I Survey" es un proyecto que comprende observaciones a alta resolución angular y sensibilidad, en línea y continuo de 21 cm, de todas las galaxias cercanas, ricas en gas, complementado por datos multi-frecuencia. Resumimos aquí los resultados de un estudio comparativo sobre tres galaxias LVHIS, acerca de la dinámica y morfología del gas. Estimamos parámetros geométricos y físicos de cada galaxia, como la inclinación, la masa total de HI, la tasa de formación estelar y la relación masa-luninosidad. Determinamos la distribución global de material y construimos el campo de velocidades. Finalmente, discutimos los resultados obtenidos.

1. Introduction

The "Local Volume H I Survey" [1] (LVHIS, Koribalski 2008) is a large project aimed at studying nearby galaxies. The project comprises 21-cm H I-line and continuum observations taken with the Australia Telescope Compact Array (ATCA), of gas-rich galaxies, up to 10 Mpc. The targets are all southern galaxies detected in HIPASS (Koribalski et al. 2004). The project provides plenty of observations to study the formation and evolution of galaxies in the Local Universe. H I spectral line observations allow to trace the overall matter distribution in galaxies, measure their velocity fields and deduce their gas dynamics and morphology (Kirby et al. 2012). The gaseous envelopes of galaxies typically

[1]LVHIS: www.atnf.csiro.au/research/LVHIS/

extend far beyond their stellar disks. Locations of star formation can usually be identified by high density H I clumps in the outer disks (Koribalski & López-Sánchez 2009). H I is also found between galaxies (Koribalski & Dickey 2004) highlighting their tidal interactions and stripping (López-Sánchez et al. 2012).

Here we present the preliminary results of an investigation about the three LVHIS galaxies ESO215–G?009, ESO223–G009 and ESO270–G017.

2. ATCA HI data

ESO215–G?009 (HIPASS J1057–48) is a low surface brightness dwarf galaxy, of type SAB(s)m. A deep study was carried out by Warren et al. (2004). Afterwards, the distance was re-estimated by Jacobs et al. 2009 (5.25 ± 0.41 Mpc) and with the new value we re-derived the galaxy parameters.

ESO0223–G009 (HIPASS 1501–48, $D = 4.3 \pm 0.75$ Mpc) is classified as IAB(s)m. This galaxy is nearly face-on and has a relatively low Galactic latitude ($b = 9.17°$). The extintion in the B band is 0.944 mag.

ESO270–G017 (HIPASS 1334–45, $D = 3.85 \pm 0.04$ Mpc) is a SBs(m) galaxy, also known as Fourcade-Figueroa. The orientation is edge-on respect to the line of sight, though the luminosity in the blue band is the highest of the three.

Koribalski (private communication) provided already-reduced UV data of ESO 215–G?009, that combines ATCA EW352, 750A and 6A array configuration observations. We have calibrated ATCA archive raw UV data towards ESO270–G017 and ESO223–G009 (configuration: EW367). Data reduction was performed with the MIRIAD software packages, and analyzed with the help of the *kvis* package. We have obtained H I-21cm line data cubes and continuum maps.

3. Results

From the data cubes we obtained the integrated H I distribution, the mean H I velocity field and the H I velocity dispersion (see Figure 1). The H I major and minor axes diameters a, b, and position angles $P.A.$ were derived from the former maps. With the global H I line spectra we computed the H I line flux density $F_{\rm HI}$, H I mass and H I column density. The inclination angle was derived as $\cos(i) = \sqrt{((b/a)^2 - p^2)/(1 - p^2)}$; p is the ratio of the smallest to the largest axis of an oblate spheroid of rotation. We adopted $p = 0.2$ (Van den Bergh 1988). In a first approximation, a maximum rotational velocity was measured using the velocity line width at 20% of the H I peak (w_{20}), corrected for galaxy inclination angle, this last assumed constant.

We obtained the rotation curve of ESO270−G017 with the task VELFIT. This method could not be applied to ESO223−G009 because it is warped, and tilted-ring modelling is required instead. Upper limits for the continuum flux density ($F_{\rm 20cm}$) were measured from the corresponding continuum maps, and used to obtain star forming rate (SFR) upper limits.

Parameter	unit	ESO223–G009	ESO270–G017	ESO215–G?009
Major axis a	kpc	18.6 ± 2.7	12.8 ± 2.1	18.2 ± 2.8
Minor axis b	kpc	18 ± 2.4	6.2 ± 1.9	16 ± 2.5
$P.A.$	deg	~115	~110	~120
Inclination i	deg	~15	~85	~29
Beam size	$'' , ''$	147×104	155×104	47×41
$M_{\rm dyn}$	10^{10}M$_\odot$	~13.0	~1.78	~2.69
$M_{\rm HI}$	10^{8}M$_\odot$	2.6 ± 0.11	10 ± 0.2	7.1 ± 0.16
$M_{\rm HI}/M_{\rm dyn}$	–	0.0025	0.056	0.026
$F_{\rm HI}$	Jy km s^{-1}	74 ± 1.58	227 ± 10	112 ± 10
$N_{\rm HI}$	10^{20} cm^{-2}	3.85 ± 1.6	17.8 ± 5.2	6.2 ± 3.5
$V_{\rm sys}$	km s^{-1}	597 ± 1	828 ± 1	598 ± 1
$M_{\rm HI}/L_{\rm B}$	M$_\odot$/L$_\odot$	0.28 ± 0.1	0.78 ± 0.12	19 ± 2.4
w_{20}	km s^{-1}	80 ± 1	155 ± 1	78.7 ± 1
$V_{\rm rot}$	km s^{-1}	155.5	77.8	80
$F_{\rm continuum}$	Jy	< 0.01	< 0.01	< 0.01
SFR	M$_\odot$yr^{-1}	< 0.013	< 0.003	< 0.002

Table 1. Measured and derived ATCA H I properties in this study.

4. Discussion

The parameters derived for the three galaxies are among those obtained by other authors (e.g. Kirby et al. 2012). The systemic velocities are very close to the ones derived from HIPASS data (Koribalski et al. 2004). The values of $M_{\rm HI}$ are slightly larger than the HIPASS ones. Some single dish H I flux can be missed from these galaxies, since the Parkes beam and the galaxies sizes are similar. Our preliminary analysis has resulted in upper limits for $F_{\rm 20cm}$. We have not detected 1.4 GHz continuum emission towards any of the studied galaxies.

It is remarkable the high mass-to-light ratio of ESO215–G?009, outlined by Warren et al. (2007). ESO270–G017 shows the largest H I flux, column density, dynamic mass, and rotational velocity, though the HI diameters are similar.

For all sources, the ratio between HI mass and $M_{\rm dyn}$ (its total mass) yielded values less than unity, which implies that the largest contribution is dark matter.

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5. References

Courteau, S. 1997, AJ, 114, 2402
Jacbos, B., et al. 2009, AJ, 138, 332
Kirby, E., Koribalski, et al. 2012, MNRAS, 420, 2924
Koribalski, B. S. 2008, A&SS Procs, p. 41
Koribalski, B. S. 2010, ASPC, 421, 137
Koribalski, B. S., et al. 2004, AJ, 128, 16
Koribalski, B. S., Dickey J. M. 2004, MNRAS, 348, 1255
Koribalski, B. S., López-Sánchez, A.R. 2009, MNRAS, 400, 1749

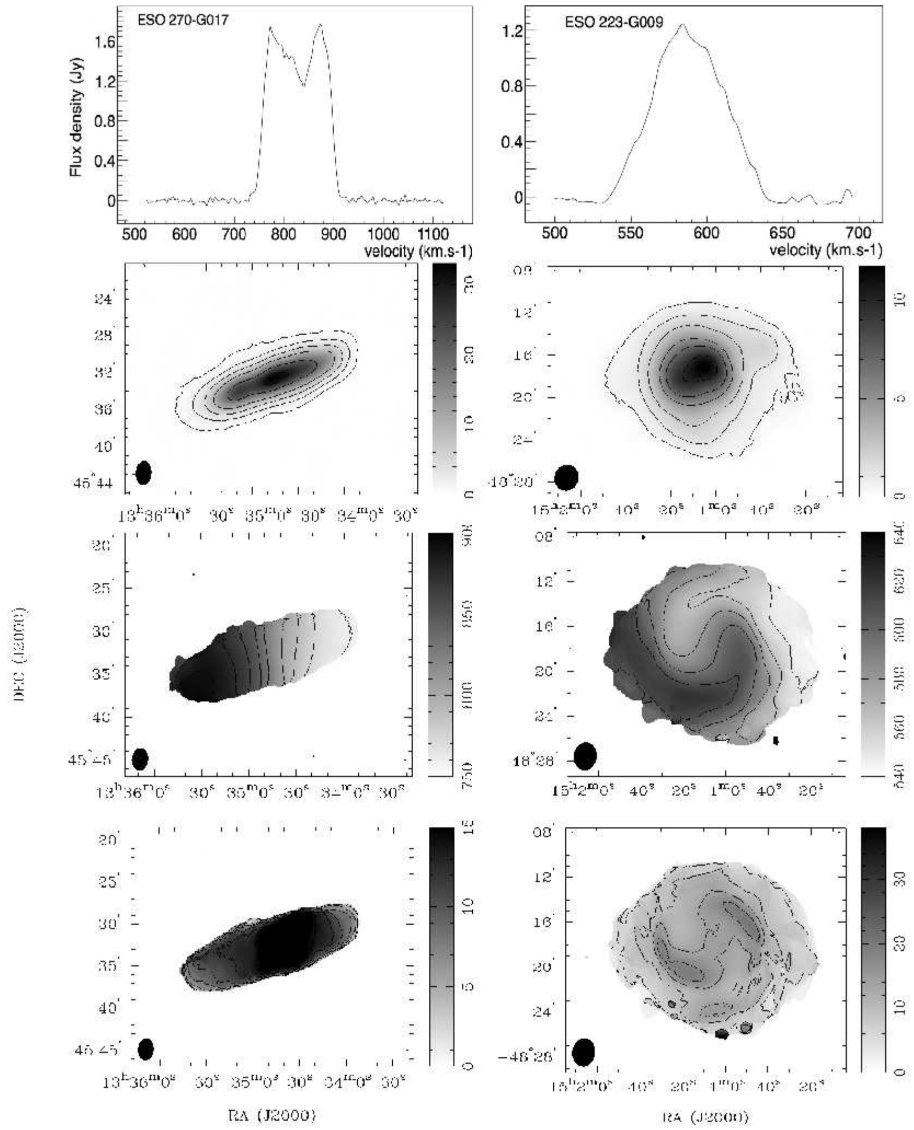

Figure 1. *Left:* HI global spectrum (first panel), integrated HI distribution (second panel), mean velocity field (third panel) and HI velocity dispersion of ESO270−G017 (bottom panel). *Right:* The same but of ESO223−G009.

López-Sánchez, A. R., Koribalski, B. S., et al. 2012, MNRAS 419, 1051
Van den Bergh, S. 1988, PASP, 100, 344
Warren, B. E., Jerjen, J., Koribalski, B. S. 2004, AJ, 128, 1152
Warren, B. E., Jerjen, J., Koribalski, B. S. 2007, AJ, 134, 1849