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$^{12}\text{CO}(1-0)$ observation of isolated late-type galaxies^{★,★★}

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Abstract. We present $^{12}\text{CO}(J = 1-0)$ line observations of 99 galaxies obtained with the SEST 15 m, the Kitt Peak 12 m and the IRAM 30 m telescopes. The target galaxies were selected from the catalogue of isolated galaxies of Karachentseva (1973). These data are thus representative of the CO properties of isolated late-type galaxies. All objects were observed in their central position, those with large angular sizes were mapped. These new measurements are used to estimate the molecular gas mass of the target galaxies. The molecular gas is on average $\sim 18\%$ of the atomic gas mass.

Key words. galaxies: spiral – ISM – intergalactic medium – star formation – radio lines: galaxies

1. Introduction

The role of the environment on the evolution of cluster galaxies is still limited by their unknown star formation history. It is still not fully understood whether spirals are affected by a systematic decrease of their star formation activity (SFA) toward the centre of clusters. Such a decrease is expected since their mean HI content, the reservoir and fuel for future star formation, is on average ~ 10 times less than in isolated objects of similar morphological type and luminosity (Haynes & Giovanelli 1984).

Since the main gas reservoir in spiral galaxies is HI (Boselli et al. 2001, 2002; Casoli et al. 1998), and because the transformation of atomic gas into molecular clouds is a necessary step before the star formation takes place (in molecular clouds), it is expected that a similar average deficiency may be encountered as well for the molecular gas of spiral galaxies near the core of rich clusters. Early studies of the CO properties of Virgo (Kenney & Young 1989) and Coma (Casoli et al. 1991) galaxies have shown that cluster spirals have, on average, a normal

molecular gas content. As pointed out by Boselli (1994) and Boselli et al. (1997, 2002), all these studies were however limited by strong observational biases induced by the use of different criteria (FIR vs. optical) in the selection of cluster and isolated galaxies.

To get rid of these biases, we constructed two reference samples of optically selected isolated galaxies. The first one, presented in Boselli et al. (1997), includes all isolated late-type galaxies extracted from the Zwicky catalogue brighter than $m_{\text{pg}} \leq 15.4$ in the Great Wall. Because of its distance (~ 90 Mpc) this sample is however limited to bright ($M_{\text{B}} \leq -19.4$) galaxies. In order to include lower luminosity ($M_{\text{B}} \leq -17.3$) objects we constructed a second reference sample by selecting ~ 100 galaxies from the catalogue of isolated galaxies of Karachentseva (1973).

A complete analysis aimed at studying the molecular gas properties of late-type galaxies based on the present set of data joint to other data available in the literature was carried out by Casoli et al. (1998). In synthesis: the gaseous phase of the interstellar medium of late-type galaxies is dominated by the atomic gas, confirming our previous results obtained on a smaller sample (Boselli et al. 1997). This result is here confirmed using a more appropriate luminosity dependent CO to H₂ conversion factor.

This paper is devoted to the presentation of the CO observations: because of its uniqueness (composed of strictly isolated, optically-selected late-type galaxies spanning the whole range

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* Tables 1 and 2 are also available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via <http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/411/381>

** Based on observations made with the 12-m National Radio Astronomical Observatory, Kitt Peak, Arizona, with the Swedish-ESO Submillimetre telescope SEST, La Silla, Chile, with the IRAM 30 m radiotelescope, Pico Veleta, Granada, Spain.

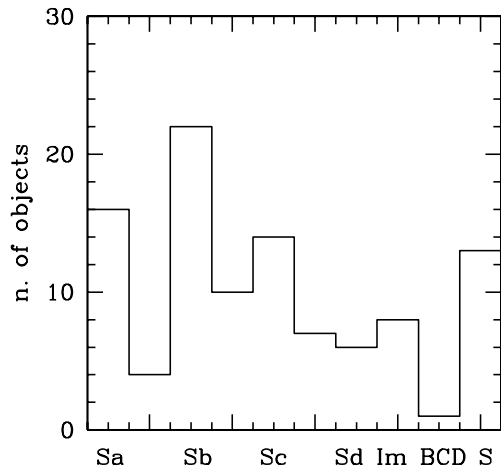


Fig. 1. The Hubble type distribution of the observed sample.

in morphological type and luminosity), this sample forms an ideal reference for any statistical study. Joint with the sample of Boselli et al. (1997), it is the unique sample with CO data including strictly isolated galaxies. The unpretentious aim of this paper is to give access to the community to these data, whose disponibility might be useful to other astronomers in future studies.

2. The sample

The sample analysed in this work has been extracted from the catalogue of isolated galaxies of Karachentseva (1973). A galaxy of diameter a is considered isolated if it is not the potential neighbor of any galaxy of diameter a_1 with $1/4a \leq a_1 \leq 4a$, within $20a_1$. The limits and quality of this criterion are extensively discussed in Haynes & Giovanelli (1984). Among the 1051 galaxies of the Karachensteva catalogue, the observed sample has been defined according to the following selection criteria:

- morphological type \geq Sa, to limit the CO observations to gas rich galaxies;
- angular diameter $0.6' \leq a \leq 3.8'$, to exclude both the extended sources, whose mapping would be too time consuming, and the compact sources, where the beam dilution would make the observations unefficient;
- total B magnitude ≤ 15.25 ;
- with an heliocentric velocity $V_{\text{hel}} \leq 14\,000 \text{ km s}^{-1}$.

Four hundred and sixty six galaxies out of 1051 included in the Karachentseva catalogue match these criteria. Of these we serendipitously extracted a subsample of 94 objects. Five objects not matching these criteria were also observed. The observed sample is thus not complete. It includes galaxies spanning the whole range in morphological type (see Fig. 1) and luminosity, from giant spirals to dwarf irregulars ($-21.2 \leq M_B \leq -17.3$), although dwarfs are undersampled.

The target galaxies are listed in Table 1 (also available in electronic form at the CDS), arranged as follows:

- Column 1: KIG designation (Karachentseva 1973).

- Column 2: alternative name, from NED.
- Columns 3 and 4: 2000 celestial coordinates with a few arcsec accuracy, from NED.
- Column 5: morphological type, from NED.
- Column 6: isolation class code, from Karachentseva (1973): 0 stands for isolated galaxies, 1 for marginally isolated and 2 for members of a group or cluster.
- Column 7: heliocentric velocity, in km s^{-1} , from NED.
- Column 8: total B magnitude as given by NED.
- Columns 9 and 10: galaxy major and minor optical blue diameters, in arcmin, as given by NED.
- Column 11: logarithm of the HI mass, from LEDA¹, determined using the relation: $M(\text{HI}) = 2.36 \times 10^5 D^2 S_{\text{HI}}$, where D is the distance of the galaxy (determined from the redshift assuming $H_0 = 75 \text{ km s}^{-1} \text{ Mpc}^{-1}$) and S_{HI} is the HI flux in Jy km s^{-1} .
- Column 12: width of the HI line (in km s^{-1}), from LEDA, measured at 50% of the maximum intensity, when available, or at 20%.
- Column 13: telescope used: S = SEST, I = IRAM, KP = Kitt Peak.

3. The observations

The observations were carried out during 4 observing runs at the SEST 15 m (November 1993–November 1996), one run at the NRAO Kitt Peak² 12 m (December 1994) done in remote from the Observatoire de Paris and one run at the IRAM 30 m telescope (June 1996).

At 115 GHz [$^{12}\text{CO}(1-0)$], the telescope half-power beam widths ($HPBW$) are 43 arcsec, 55 arcsec and 22 arcsec respectively.

The SEST observations were carried out during fairly good weather conditions. The pointing accuracy was checked every 4 hours by broad band continuum observations of bright continuum sources, with an average error of 4 arcsec rms. We used a Schottky receiver in single sideband mode with typical system temperatures T_{sys} of ~ 500 – 600 K (in the T_A^* scale). We used a 6 Hz dual beam-switching procedure, with two symmetric reference positions offset by 12 arcmin in azimuth. The backend was an acousto-optical spectrometer of 1440 channels of width 1.4 MHz. Each 12-min scan began with a chopper wheel calibration on a load at ambient temperature and on a cold load.

The Kitt Peak observations were carried out in relatively good weather conditions, with typical zenith opacities of 0.30–0.45. The pointing accuracy was checked every night by broad band continuum observations of Saturn and/or 3C273, with an average error of 7 arcsec rms. We used a dual-polarization SIS mixer, with a receiver temperature for each polarization of about $T_{\text{sys}} = 260$ – 400 K (in T_R^* scale) at the elevation of the sources. We used a dual beam-switching procedure, with two symmetric reference positions offset by 4' in azimuth. The backend was a 256 channel filter bank spectrometer with

¹ Lyon Extragalactic DAtabase, <http://leda.univ-lyon1.fr/>

² The Kitt Peak 12-m telescope was operated by Associated Universities, Inc., under cooperative agreement with the National Science Foundation.

Table 1. The target galaxies.

KIG	Name	RA(2000) h m s	Dec(2000) ° ' arcsec	Type	Agg	Vel km s ⁻¹	Mag	<i>a</i> '	<i>b</i> '	<i>M</i> (HI) <i>M</i> _⊙	ΔV_{HI} km s ⁻¹	Tel
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	UGC 5	00 03 05.6	-01 54 49	SABbc	0	7271	13.97	1.8	0.9	10.07	458	S
4	NGC 7817	00 03 58.7	+20 45 03	SAbc: s	0	2309	12.56	3.5	0.9	9.55	398	KP
6	NGC 9	00 08 54.7	+23 49 04	Sb: pec	2	4528	14.35	1.3	0.7	9.41	163	KP
11	UGC 139	00 14 31.8	-00 44 15	SAB(s)c	0	3963	14.49	2.1	1.0	9.93	290	S
22	IC 1551	00 27 35.4	+08 52 38	Sc	0	13040	14.30	2.5	1.2	9.59	146	S
33	NGC 237	00 43 27.8	-00 07 30	SAB(rs)	0	4175	13.70	1.6	0.9	9.82	296	S
45	UGC 685	01 07 22.4	+16 41 02	Im/BCD	0	157	14.23	1.2	0.9	7.14	71	KP
53	NGC 575	01 30 46.7	+21 26 25	SB(rs)c	0	3128	13.45	1.7	1.6	9.43	141	KP
56	NGC 622	01 36 00.1	+00 39 49	SB(rs)b	0	5161	13.71	1.8	1.3	9.79	372	S
59	UGC 1167	01 38 20.8	+07 32 02	SA(rs)c	0	4303	14.00	2.7	2.1	9.86	215	S
68	NGC 718	01 53 13.3	+04 11 44	SAB(s)a	0	1733	12.59	2.3	2.0	7.38	177	S
72	UGC 1395	01 55 22.0	+06 36 43	SA(rs)b	0	5208	14.18	1.3	1.0	9.50	255	S
87	UGC 1587	02 05 37.3	+06 46 19	Sa	0	5658	14.60	1.0	0.4	9.84	368	S
94	UGC 1706	02 13 33.9	+25 51 20	Scd:	0	4794	14.73	1.0	0.4	9.42	275	KP
115	IC 1825	02 38 55.5	+09 05 49	Scd:	0	5125	14.55	1.2	0.8	10.08	293	S
123	IC 302	03 12 51.3	+04 42 25	SB(rs)b	0	5904	13.59	1.9	1.5	10.44	249	S
139	NGC 1507	04 04 27.2	-02 11 18	SB(s)m	0	863	12.89	3.6	0.9	9.09	167	S
153	NGC 1544	05 02 36.1	+86 13 20	S0	0	3937	14.16	1.3	0.9	-	-	I
155	IC 391	04 57 21.3	+78 11 26	SA(s)c	0	1556	13.00	1.1	1.1	9.14	145	KP
166	UGC 3420	06 16 01.4	+75 56 11	Sb	0	5106	14.10	2.6	0.8	10.26	475	I
176	UGC 3581	06 59 02.8	+80 00 13	SAB(rs)	0	4955	13.74	1.3	1.1	9.81	260	KP
180	NGC 2344	07 12 28.6	+47 10 00	SA(rs)c	0	974	12.81	1.7	1.7	8.91	147	KP
191	UGC 3863	07 28 54.1	+49 08 13	(R')SBa	0	5918	14.01	1.2	0.6	9.55	460	KP
278	UGC 4531	08 41 53.0	+32 52 03	Sb	0	7728	14.56	1.1	0.4	9.81	466	KP
279	NGC 2644	08 41 31.8	+04 58 49	S?	0	1939	13.31	2.1	0.8	9.07	201	S
291	UGC 4684	08 56 40.7	+00 22 30	SA(rs)d	0	2522	14.00	1.4	1.1	9.42	157	I
298	NGC 2746	09 05 59.4	+35 22 38	SB(rs)a	0	7065	14.00	1.6	1.5	9.89	255	KP
300	UGC 4781	09 06 34.4	+06 18 13	Scd:	0	1443	14.32	1.9	0.6	9.15	143	I
303	NGC 2765	09 07 36.7	+03 23 34	S0	2	4064	13.08	2.1	1.1	-	-	S
339	UGC 5055	09 30 11.7	+55 51 09	(R')SB	2	7541	14.20	1.5	1.3	10.27	222	KP
343	NGC 2900	09 30 15.1	+04 08 39	SBcd:	0	5346	13.70	1.7	1.4	9.94	122	S
359	NGC 2960	09 40 36.4	+03 34 37	Sa?	0	4932	13.29	1.8	1.2	9.29	435	S
363	NGC 2977	09 43 46.7	+74 51 35	Sb:	0	3044	13.30	1.8	0.8	9.08	339	KP
383	NGC 3049	09 54 49.6	+09 16 17	SB(rs)a	0	1494	13.04	2.2	1.4	9.11	200	S
401	IC 594	10 08 32.0	-00 40 01	SB(r)bc	0	6426	14.01	1.0	0.5	9.68	417	S
443	NGC 3376	10 47 26.5	+06 02 53	S0	0	5830	14.80	0.8	0.4	-	-	S
444	IC 651	10 50 58.4	-02 09 01	SB(s)m	0	4469	13.43	0.8	0.8	9.65	192	S
464	NGC 3526	11 06 56.8	+07 10 28	SAC pec	0	1420	13.86	1.9	0.4	8.89	197	S
489	UGC 6568	11 35 36.9	+00 07 40	SB(s)m	0	5955	14.70	0.8	0.4	9.39	206	I
491	UGC 6608	11 38 33.3	-01 11 04	SAB(r)a	0	6189	14.75	1.2	0.8	-	-	S
492	IC 716	11 39 03.3	-00 12 22	Sbc pec	0	5429	14.80	1.6	0.3	9.81	460	S
499	UGC 6769	11 47 43.7	+01 49 34	SB(r)b:	0	8537	14.65	1.2	0.5	10.21	470	I
500	UGC 6771	11 48 00.2	+04 29 18	(R')SAB	0	5964	13.60	1.7	1.6	9.43	287	S
502	UGC 6780	11 48 50.4	-02 01 57	SAB(s)d	0	1729	15.25	3.2	1.0	9.63	223	S
509	UGC 6879	11 54 25.0	-02 19 08	SAB(r)d	0	2383	14.08	1.7	0.6	9.08	246	S
512	UGC 6903	11 55 36.9	+01 14 14	SB(s)cd	0	1892	13.00	2.6	2.3	9.53	180	I
527	NGC 4348	12 23 53.9	-03 26 35	SAbc: s	0	2005	13.01	3.2	0.7	9.37	381	S
540	UGC 7798	12 38 03.3	-02 15 50	IBm:	0	2568	14.33	0.9	0.5	9.03	206	S
545	NGC 4617	12 41 06.1	+50 23 32	Sb	0	4655	14.01	3.0	0.5	10.15	458	KP
547	NGC 4635	12 42 39.1	+19 56 40	SAB(s)d	0	960	13.20	2.0	1.4	8.48	166	KP
604	NGC 5377	13 56 16.6	+47 14 08	(R)SB(s)	0	1793	12.24	3.7	2.1	9.16	375	I
605	NGC 5375	13 56 56.0	+29 09 52	SB(r)ab	2	2386	12.40	3.2	2.8	9.49	285	KP
626	NGC 5584	14 22 23.6	-00 23 09	SAB(rs)	0	1635	12.63	3.4	2.5	9.50	196	S
638	NGC 5690	14 37 41.0	+02 17 28	Sc? sp	0	1753	12.50	3.4	1.0	9.58	294	S

Table 1. continued.

KIG	Name	RA(2000)	Dec(2000)	Type	Agg	Vel	Mag	a	b	$M(\text{HI})$	ΔV_{HI}	Tel
(1)	(2)	h m s	° ' arcsec	(5)	(6)	km s $^{-1}$	(8)	'	'	M_{\odot}	km s $^{-1}$	(13)
652	NGC 5768	14 52 08.1	-02 31 48	SA(rs)c	0	1962	13.65	1.9	1.4	9.38	184	S,KP
653	NGC 5772	14 51 38.9	+40 35 57	SA(r)b:	1	4900	13.64	2.1	1.3	9.74	501	KP
669	NGC 5913	15 20 55.4	-02 34 41	SB(r)a	0	2004	13.87	1.6	0.7	8.69	345	I
695	CGCG 78-047	15 40 53.4	+09 45 00	Sa	0	10459	14.60	0.8	0.6	-	-	S
712	NGC 6012	15 54 13.9	+14 36 04	(R)SB(r)	0	1854	12.69	2.1	1.5	9.51	164	KP
772	IC 1231	16 46 59.0	+58 25 23	Scd:	0	2937	13.59	2.2	1.0	9.39	381	KP
785	UGC 10685	17 04 50.9	+12 55 28	Sb	0	9642	14.50	1.8	0.6	10.25	434	KP
786	UGC 10699	17 06 19.1	+10 22 31	Sb	0	6275	14.70	0.6	0.5	9.36	235	S
791	UGC 10743	17 11 30.7	+07 59 40	Sa?	0	2569	14.74	1.1	0.4	9.03	213	S
800	NGC 6347	17 19 54.7	+16 39 39	SBb	2	6143	14.47	1.2	0.7	9.73	370	S
808	UGC 10862	17 28 08.9	+07 25 20	SB(rs)c	0	1691	13.40	2.8	2.5	9.32	133	S
812	NGC 6389	17 32 39.8	+16 24 06	Sbc	0	3119	12.82	2.8	1.9	10.18	393	KP
840	UGC 11058	17 56 55.0	+32 38 12	SB(s)b	0	4757	13.29	1.5	1.1	9.65	278	KP
850	NGC 6643	18 19 46.6	+74 34 10	SA(rs)c	2	1484	11.73	3.8	1.9	9.52	323	KP
851	NGC 6654	18 24 07.6	+73 10 59	(R')SB	2	1821	13.00	2.6	2.1	-	-	KP
862	NGC 6711	18 49 00.9	+47 39 29	SBbc:	0	4671	13.70	1.3	1.3	9.39	187	KP
879	UGC 11575	20 30 07.6	+03 03 05	SB(s)d	0	3980	14.56	1.4	0.5	9.53	305	S
886	NGC 6954	20 44 03.2	+03 12 34	SA0+?	0	4067	14.10	1.0	0.6	-	-	S
889	NGC 6969	20 48 27.6	+07 44 23	Sa	0	4660	14.89	1.1	0.3	8.75	429	S
890	UGC 11635	20 43 29.7	+80 09 22	Sbc	0	4804	13.80	2.9	1.2	10.13	485	KP
897	NGC 7025	21 07 47.3	+16 20 08	Sa	0	4968	13.71	1.9	1.3	9.47	594	KP
906	UGC 11723	21 20 17.5	-01 41 03	Sb	0	4899	14.70	1.9	0.3	9.82	435	S,KP
910	IC 5104	21 21 29.3	+21 14 30	SBab?	0	4958	14.27	1.6	0.4	9.83	423	KP
911	NGC 7056	21 22 07.5	+18 39 57	SBb	0	5376	13.75	1.0	0.9	9.36	233	S
930	IC 1401	21 46 59.5	+01 42 45	SAB(r)b	0	4721	14.41	1.8	0.7	9.94	364	S
935	NGC 7156	21 54 33.7	+02 56 34	SAB(rs)	0	3985	13.11	1.6	1.4	9.57	100	S
940	UGC 11871	22 00 41.4	+10 33 09	Sb	0	7978	14.48	1.1	0.7	9.68	253	S
949	UGC 11921	22 09 15.4	+14 21 38	IBm	0	1678	14.35	1.7	0.7	9.04	144	S
976	NGC 7328	22 37 29.2	+10 31 54	Sab	0	2825	13.98	2.0	0.7	9.70	314	KP
984	NGC 7367	22 44 34.6	+03 38 44	Sab:	0	7235	14.67	1.5	0.4	9.74	570	KP
985	UGC 12178	22 45 08.5	+06 25 48	SAB(s)d	0	1931	13.60	3.0	1.6	9.69	221	S
1001	NGC 7428	22 57 19.5	-01 02 56	(R)SAB	0	3078	13.40	2.4	1.3	9.70	316	S
1003	UGC 12304	23 01 08.4	+05 39 14	Sc	0	3470	14.72	1.7	0.2	9.13	270	S
1006	UGC 12372	23 07 00.8	+35 46 39	Sm	0	5480	14.52	0.8	0.6	9.74	268	KP
1009	NGC 7514	23 12 25.8	+34 52 53	Sa	1	4843	13.54	1.4	0.9	9.41	317	KP
1013	UGC 12474	23 16 43.3	+33 59 44	Sa	2	5117	14.24	1.2	0.4	9.12	357	KP
1019	NGC 7664	23 26 39.7	+25 04 49	Sc:	0	3474	13.42	1.4	0.8	10.16	329	KP
1023	UGC 12646	23 31 39.0	+25 56 44	SB(r)b	1	8034	13.99	1.9	1.5	9.95	178	KP
1027	UGC 12688	23 35 26.2	+07 19 20	Sm	0	5229	14.27	1.7	0.4	10.00	320	S
1028	NGC 7712	23 35 51.6	+23 37 07	E	0	3053	13.74	0.9	0.8	9.35	179	KP
1036	IC 1508	23 45 55.0	+12 03 43	Sdm:	0	4263	13.87	2.0	0.5	10.00	321	KP
1038	UGC 12776	23 46 12.2	+33 22 12	SB(rs)b	1	4937	13.70	2.5	2.1	10.24	247	KP
1039	IC 5355	23 47 15.4	+32 46 59	SBcd:	0	4855	14.39	1.0	0.6	9.30	229	KP
1044	UGC 12840	23 54 30.1	+28 52 21	(R)SAB	1	6856	14.06	1.2	1.1	9.68	236	KP
1047	UGC 12857	23 56 47.5	+01 21 19	Sbc: sp	0	2459	14.49	1.8	0.4	9.57	265	S

channel width of 2 MHz. Each 6-min scan began by a chopper wheel calibration on a load at ambient temperature, with a chopper wheel calibration on a cold load every two scans.

The IRAM observations were carried out in good weather conditions. Pointing was checked using continuum sources every 90 min, with an average error of 3 arcsec rms. We used two SIS receivers in parallel and two 512×1 MHz backends and the autocorrelator as back ends. T_{sys} was of the order 280–330 K. We used a wobbler switching procedure, with a wobbler throw of $4'$ in azimuth. Each 6-min scan began by a chopper wheel calibration on a load at ambient temperature and a cold load.

Galaxies were all observed at their nominal coordinates listed in Table 1. Twenty-eight among the largest-brightest optical sources were mapped, with one beam sampling along the major axis for inclined galaxies or along major and minor axis for face-on objects. The total integration time was on average 120 min on+off (i.e. 60 min on the source) per position, yielding rms noise levels of about 4 mK (in the T_{mb} scale) at the SEST, 2 at Kitt Peak and 6 at IRAM, after velocity smoothing to 15 km s^{-1} . The baselines were flat owing to the use of beam-switching, thereby requiring that only linear baselines be subtracted. The antenna temperature T_{A}^* (SEST, IRAM) and T_{R}^* (Kitt Peak) were corrected for telescope and atmospheric losses. In the following analysis we use the main-beam brightness temperature scale, T_{mb} , with $T_{\text{mb}} = T_{\text{A}}^*/0.69$ at the SEST, $T_{\text{mb}} = T_{\text{A}}^*/0.56$ at IRAM and $T_{\text{mb}} = T_{\text{R}}^*/0.84$ (where the main beam efficiency is $\eta_{\text{mb}} = 0.54$ and the forward scattering and spillover efficiency $\eta_{\text{fss}} = 0.68$) at Kitt Peak. This scale is appropriate for sources with sizes comparable to, or smaller than the beam size. These main-beam temperatures can be converted into flux densities using 27 Jy/K at the SEST, 29 Jy/K at Kitt Peak and 4.4 Jy/K at IRAM.

4. Results

4.1. Results of our observations

The $^{12}\text{CO}(1-0)$ spectra of all the detected galaxies were reduced with the CLASS package (Forveille et al. 1990): the observational results are listed in Table 2 (also available in electronic form at the CDS). All data are given in the T_{mb} scale. Of the 99 observed galaxies 30 were not detected. Table 2 is arranged as follows:

- Column 1: KIG name.
- Columns 2 and 3: offset position, in arcsec.
- Column 4: rms noise, in mK.
- Column 5: intensity of the $I(\text{CO})$ line ($I(\text{CO}) = \int T_{\text{mb}} dv$) in K km s^{-1} (first line moment definition)). For undetected galaxies, the reported value is an upper limit determined as follows:

$$I(\text{CO}) = 2\sigma(\Delta V_{\text{HI}}\delta V_{\text{CO}})^{1/2} \text{ K km s}^{-1} \quad (1)$$

where σ is the rms noise of the spectrum, ΔV_{HI} is the HI line width, and δV_{CO} is the spectral resolution (for galaxies with ΔV_{HI} not available, the HI width has been determined assuming a standard $\Delta V_{\text{HI}} = 300 \sin(i) \text{ km s}^{-1}$, where i is the galaxy inclination or $\Delta V_{\text{HI}} = 50 \text{ km s}^{-1}$ if

$i = 0$). $\delta V_{\text{CO}} = 15 \text{ km s}^{-1}$. For undetected pointings in mapped galaxies, we estimate a conservative upper limit using ΔV_{HI} in Eq. (1), since generally $\Delta V_{\text{HI}} > \Delta V_{\text{CO}}$. The error on the intensity of the CO line, $\Delta I(\text{CO})$, is computed as:

$$\Delta I(\text{CO}) = 2\sigma(\Delta V_{\text{CO}}\delta V_{\text{CO}})^{1/2} \text{ K km s}^{-1} \quad (2)$$

where σ is the rms noise of the spectrum, ΔV_{CO} is the CO linewidth (given in Col. 7), and δV_{CO} is the spectral resolution³. Spectra were smoothed to $\delta V_{\text{CO}} = 15 \text{ km s}^{-1}$.

- Column 6: heliocentric velocity determined from the CO line (second line moment), in km s^{-1} (optical definition $v = cz = \Delta\lambda/\lambda_0$). The estimated error is comparable to the resolution, thus $\sim 15 \text{ km s}^{-1}$.
 - Column 7: width at 50% of the maximum intensity of the CO line, in km s^{-1} , with an estimated error of $\sim 15\text{--}20 \text{ km s}^{-1}$.
 - Column 8: notes: m stands for marginally detected galaxies, a for nearby galaxies whose distance determination from redshift measurements are highly inaccurate ($v_{\text{hel}} \leq 1000 \text{ km s}^{-1}$).
 - Column 9: filling factor, defined as the ratio of the beam area to the optical surface of the galaxy. For mapped galaxies the beam area is the total mapped area, including detected and undetected positions.
 - Column 10: the $M(\text{H}_2)_{\text{CO}}$ mass (or upper limit), determined adopting a standard X conversion factor $X = 2.3 \times 10^{20} \text{ mol cm}^{-2} (\text{K km s}^{-1})^{-1}$ (Strong et al. 1988):
- $$M(\text{H}_2)_{\text{CO}} = 68.08 \times (D/\text{Mpc})^2 I(\text{CO}) (\text{K km s}^{-1}) (\theta/1'')^2 \quad (3)$$
- where in mapped galaxies $I(\text{CO})$ is the sum of the intensities $I_i(\text{CO})$ of each detected beam position given in Col. 5 of Table 2, $I(\text{CO}) = \sum_{i=1}^n I_i(\text{CO})$ (K km s^{-1}). The distance is determined from redshift measurements assuming $H_0 = 75 \text{ km s}^{-1} \text{ Mpc}^{-1}$;
- Column 11: the molecular gas mass determined from the CO line intensity assuming the M_{B} absolute magnitude-dependent X conversion factor given in Table 5 of Boselli et al. (2002).

4.2. Comparison with previous observations

Two galaxies: KIG 652 and KIG 906, have been observed both at the SEST and at Kitt Peak. The Kitt Peak observations of

³ Both Eqs. (1) and (2) assume that the uncertainty is due to noise in the spectrum, ignoring the error on the determination of the baseline. As suggested by Sage (1993) this uncertainty can be taken into account by combining in quadratic sum the error due to noise in the spectrum ($\Delta I(\text{CO})_{\text{noise}} = \sigma(\Delta V_{\text{CO}}\delta V_{\text{CO}})^{1/2}$) to that in the determination of the baseline ($\Delta I(\text{CO})_{\text{baseline}} = \sigma\Delta V_{\text{CO}}(\delta V_{\text{CO}}/\Delta V_{\text{baseline}})^{1/2}$, where $\Delta V_{\text{baseline}}$ is the velocity range over which the baseline is fitted. Since $\Delta V_{\text{baseline}} < \Delta V_{\text{CO}}$ for all the observed galaxies (ΔV_{CO} is always $< 500 \text{ km s}^{-1}$, for a bandwidth of $\sim 1300 \text{ km s}^{-1}$ for the Kitt Peak and IRAM observations, and significantly larger at the SEST), it results that $\sqrt{\Delta I(\text{CO})_{\text{noise}}^2 + \Delta I(\text{CO})_{\text{baseline}}^2} < \Delta I(\text{CO})/\sqrt{2}$, where $\Delta I(\text{CO})$ is the value given in Eq. (2). Thus our error determination, even though it does not exactly corresponds to a “two σ error”, is more conservative than a “one σ error” obtained taking into account the uncertainty due to the baseline determination.

Table 2. Results of the observations, in T_{mb} scale.

KIG	Offset arcsec	Offset arcsec	rms mK	$I(\text{CO})$ K km s $^{-1}$	$V(\text{CO})$ km s $^{-1}$	ΔV_{CO} km s $^{-1}$	Notes	FF	$\log M(\text{H}_2)_{\text{CO}}$ M_{\odot}	$\log M(\text{H}_2)$ M_{\odot}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	0	0	4.1	1.99 ± 0.55	7322	302	m	0.32	9.37	9.01
4	0	0	2.7	5.71 ± 0.36	2345	292		0.27	9.05	8.88
6	0	0	2.1	<0.21				0.92	<8.19	<8.08
11	0	0	3.9	<0.51				0.24	<8.26	<8.22
22	0	0	3.1	0.94 ± 0.31	13131	166		0.17	9.55	9.02
33	0	0	4.6	3.53 ± 0.56	4156	243		1.78	9.14	8.94
33	-41	11	11.0	<1.47						
33	-41	-11	11.0	<1.47						
33	41	-11	11.0	<1.47						
33	41	11	11.0	<1.47						
45	0	0	2.9	<0.19			a	0.78	<5.23	<6.41
53	0	0	3.4	1.25 ± 0.27	3125	104		0.31	8.65	8.52
56	0	0	3.0	1.18 ± 0.41	5142	317	m	0.22	8.85	8.57
59	0	0	5.6	1.07 ± 0.69	4357	250		0.45	9.46	9.31
59	-37	22	7.7	<0.87						
59	-22	-37	7.7	<0.87						
59	22	37	9.8	1.69 ± 0.64	4450	71				
59	37	-22	12.0	4.22 ± 1.36	4148	-1	m			
68	0	0	5.8	<0.60				0.56	<7.60	<7.55
68	-31	-31	10.5	<1.08						
68	-31	31	10.5	<1.08						
68	31	31	10.5	<1.08						
68	31	-31	10.5	<1.08						
72	0	0	3.6	1.80 ± 0.47	5160	287		0.40	9.04	8.84
87	0	0	2.5	0.41 ± 0.26	5652	181	m	1.28	8.47	8.31
94	0	0	2.0	0.44 ± 0.29	4770	347	m	2.10	8.57	8.50
115	0	0	7.2	<0.95				0.54	<8.75	<8.63
123	0	0	5.5	1.40 ± 0.66	5910	242		0.18	9.04	8.69
139	0	0	7.0	<0.70				0.48	<7.07	<7.34
139	8	42	5.1	<0.51						
139	-8	-42	4.3	<0.43						
153	0	0	5.5	<0.64				0.34	8.15	8.06
153	-15	13	6.7	<0.78						
153	15	-13	6.0	1.57 ± 0.64	-	-	m			
155	0	0	3.2	1.32 ± 0.20	1570	63		0.69	8.07	8.13
166	0	0	4.5	2.84 ± 0.60	5005	297		0.19	8.64	8.43
166	-10	17	11.6	<1.96						
166	10	-17	10.0	<1.69						
176	0	0	2.1	0.79 ± 0.26	4993	250		0.59	8.85	8.59
180	0	0	2.0	0.63 ± 0.12	982	63		0.29	7.34	7.55
191	0	0	1.6	0.67 ± 0.23	6025	334	m	1.17	8.93	8.66
278	0	0	1.8	<0.30				1.91	<8.82	<8.54
279	0	0	5.4	<0.59				0.92	<7.70	<7.73
279	-11	44	4.6	<0.51						
279	11	-44	8.5	<0.93						
291	0	0	3.1	0.72 ± 0.18	2531	54		0.44	7.43	7.48
291	-20	0	10.0	<0.97						
291	0	20	8.6	<0.83						
291	0	-20	10.0	<0.97						
291	20	0	8.1	<0.79						
298	0	0	1.2	0.99 ± 0.13	7052	208		0.35	9.26	8.91
300	0	0	5.7	<0.53				0.35	7.07	7.40
300	16	-12	6.3	<0.58						
300	-16	12	6.5	0.96 ± 0.60	-	-	m			
303	0	0	6.8	<0.83				0.67	<8.49	<8.19
303	-41	13	11.0	<1.34						
303	41	-13	7.3	<0.79						
339	0	0	2.2	1.20 ± 0.23	7541	188		0.43	9.40	9.06

Table 2. continued.

KIG	Offset arcsec	Offset arcsec	rms mK	$I(\text{CO})$ K km s^{-1}	$V(\text{CO})$ km s^{-1}	ΔV_{CO} km s^{-1}	Notes	FF	$\log M(\text{H}_2)_{\text{CO}}$ M_{\odot}	$\log M(\text{H}_2)$ M_{\odot}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
343	0	0	3.3	2.37 ± 0.31	5362	151	m	0.22	9.18	8.89
359	0	0	2.5	<0.40				0.71	<8.34	<8.01
359	-28	-33	6.7	<1.08						
359	28	33	6.7	<1.08						
363	0	0	2.4	2.43 ± 0.33	3041	312		0.58	8.92	8.77
383	0	0	6.2	1.41 ± 0.49	1498	105		0.50	7.85	7.93
383	-18	-39	9.1	<1.00						
383	18	39	9.1	<1.00						
401	0	0	2.8	<0.44				1.03	<8.61	<8.30
443	0	0	5.3	<0.67				1.61	<8.71	<8.58
444	0	0	4.7	3.17 ± 0.24	4474	45		0.80	9.15	8.88
464	0	0	4.8	1.15 ± 0.57	1462	235	m	2.03	8.34	8.59
464	-35	-25	10.0	1.51 ± 1.00	1509	168	m			
464	35	25	7.0	2.20 ± 0.76	1578	-	m			
489	0	0	3.3	2.61 ± 0.37	5980	205		1.26	8.73	8.58
489	0	-20	7.2	<0.80						
489	0	20	6.6	<0.73						
491	0	0	4.7	<0.44				0.54	<8.57	<8.41
492	0	0	3.5	<0.58				1.07	<8.58	<8.48
499	0	0	4.4	5.61 ± 0.66	8624	380		0.67	9.71	9.40
499	-19	-6	7.2	0.75 ± 1.21	8401	-	m			
499	19	6	7.6	1.31 ± 1.28	-	-	m			
500	0	0	3.5	<0.46				0.19	<8.56	<8.21
502	0	0	4.0	1.18 ± 0.26	1785	70	m	0.48	7.90	8.32
502	-15	-40	8.4	<0.97						
502	15	40	9.1	<1.05						
509	0	0	4.9	<0.60				1.51	8.43	8.52
509	9	-42	7.0	<0.85						
509	-9	42	7.0	2.10 ± 0.36	3118	45	m			
512	0	-20	6.6	1.36 ± 0.65	1924	162		0.11	8.07	8.06
512	0	20	6.7	<0.70						
512	20	0	7.4	<0.77						
512	0	0	3.5	0.99 ± 0.35	1924	162				
512	-20	0	7.3	3.24 ± 0.83	1885	216				
527	0	0	5.5	4.32 ± 0.73	2033	297		0.69	8.71	8.66
527	-28	33	7.7	<1.16						
527	28	-33	7.7	1.44 ± 0.69	2168	135				
540	0	0	3.0	<0.33				1.14	<7.69	<7.80
545	0	0	1.9	1.87 ± 0.29	4666	375		0.56	9.17	8.99
547	0	0	2.5	0.65 ± 0.15	931	62		0.30	7.34	7.63
604	0	0	4.0	5.38 ± 0.56	1717	332		0.12	8.42	8.29
604	-20	0	6.0	<0.90						
604	0	20	8.7	<1.31						
604	0	-20	7.0	<1.05						
604	7	19	6.3	<0.95						
604	20	0	9.6	<1.44						
604	-7	-19	9.2	8.64 ± 1.32	1776	345				
605	0	0	2.2	0.78 ± 0.18	2439	106		0.09	8.21	8.00
626	0	0	2.9	1.14 ± 0.26	1640	136	m	0.06	7.83	7.81
638	0	0	5.0	4.60 ± 0.60	1813	243		0.45	8.76	8.69
638	26	-34	7.7	<1.02						
638	-26	34	7.7	3.80 ± 0.48	1832	65				
652	0	0	3.5	1.39 ± 0.38	1931	196		0.58	8.51	8.60
652	-37	-22	6.1	<0.64						
652	37	22	6.8	0.52 ± 0.71	-	-	m			
653	0	0	1.9	0.83 ± 0.33	4982	495		0.31	8.86	8.59
669	0	0	5.2	2.63 ± 0.73	1922	330	m	0.84	8.83	8.95
669	0	40	18.0	<2.59						
669	20	0	11.0	<1.58						
669	-20	0	11.4	2.84 ± 1.64	-	-	m			
669	0	20	9.3	6.92 ± 1.19	2265	272				

Table 2. continued.

KIG	Offset arcsec	Offset arcsec	rms mK	$I(\text{CO})$ K km s^{-1}	$V(\text{CO})$ km s^{-1}	ΔV_{CO} km s^{-1}	Notes	FF	$\log M(\text{H}_2)_{\text{CO}}$ M_{\odot}	$\log M(\text{H}_2)$ M_{\odot}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
669	0	-40	8.7	6.94 ± 1.21	1950	324				
669	0	-20	9.0	9.14 ± 1.45	1991	432				
695	0	0	3.4	0.91 ± 0.29	10549	121		1.07	9.35	8.95
712	0	0	2.7	1.72 ± 0.29	1853	186		0.27	8.34	8.27
772	0	0	1.7	1.40 ± 0.15	5152	125		0.38	8.65	8.57
785	0	0	1.8	<0.29				0.48	<8.78	<8.40
786	0	0	3.1	1.84 ± 0.35	6299	211		1.71	9.21	9.03
791	0	0	3.5	0.92 ± 0.33	2589	151	m	1.17	8.13	8.31
800	0	0	2.7	1.78 ± 0.38	6150	332		0.61	9.18	8.97
808	0	0	3.8	0.32 ± 0.26	1687	76	m	0.37	7.82	7.93
808	-45	0	7.3	<0.65						
808	45	0	7.3	<0.65						
808	0	45	6.6	0.33 ± 0.59	1657	-	m			
808	0	-45	7.3	0.39 ± 0.65	-	-	m			
812	0	0	3.9	2.28 ± 0.57	3141	352		0.16	8.91	8.67
840	0	0	2.0	1.58 ± 0.22	4787	196		0.51	9.12	8.80
850	0	0	3.5	11.40 ± 0.39	1503	209		0.12	8.96	8.82
851	0	0	2.5	<0.26				0.15	<7.50	<7.51
862	0	0	3.1	3.00 ± 0.33	4682	188		0.50	9.38	9.14
879	0	0	4.1	<0.55				0.73	<8.29	<8.27
886	0	0	2.5	<0.30				0.86	<8.05	<7.93
889	0	0	2.6	<0.42				1.56	<8.31	<8.28
890	0	0	2.7	4.31 ± 0.47	4799	498		0.24	9.56	9.33
897	0	0	2.2	<0.42				0.34	<8.57	<8.31
906	0	0	4.2	2.30 ± 0.52	4946	257		2.70	9.09	9.01
906	-23	-36	3.8	<0.61						
906	23	36	3.8	<0.61						
910	0	0	1.5	<0.24				1.31	<8.33	<8.17
911	0	0	4.3	2.94 ± 0.70	5329	438	m	0.57	9.28	8.99
930	0	0	3.7	<0.55				0.41	<8.44	<8.32
935	0	0	6.1	3.10 ± 0.41	3967	76		1.15	9.04	8.76
935	-42	11	5.6	<0.43						
935	-15	40	8.5	<0.66						
935	15	-40	8.1	<0.63						
935	42	-11	5.6	<0.43						
940	0	0	3.3	4.70 ± 0.44	8051	302		0.67	9.83	9.52
949	0	0	9.1	<0.85				0.43	<7.73	<8.00
976	0	0	2.5	3.05 ± 0.33	2844	292		0.60	8.95	8.96
984	0	0	1.7	<0.31				1.40	<8.78	<8.54
985	0	0	3.8	<0.44				0.11	<7.56	<7.65
1001	0	0	3.8	1.02 ± 0.52	-	-	m	0.49	8.33	8.20
1001	-15	40	7.7	<1.06						
1001	15	-40	7.7	<1.06						
1003	0	0	3.2	1.56 ± 0.42	3475	287		1.51	8.62	8.68
1006	0	0	2.0	1.65 ± 0.21	5465	181		1.75	9.26	9.10
1009	0	0	1.5	0.71 ± 0.16	4871	195	m	0.67	8.79	8.50
1013	0	0	1.6	2.67 ± 0.27	5011	478		1.75	9.41	9.23
1019	0	0	4.2	2.98 ± 0.56	3485	292		0.75	9.12	8.94
1023	0	0	1.3	0.82 ± 0.13	8042	166		0.29	9.29	8.89
1027	0	0	6.2	<0.86				0.76	<8.72	<8.54
1028	0	0	2.0	0.82 ± 0.19	3066	151		1.17	8.45	8.38
1036	0	0	2.8	1.73 ± 0.28	4264	166		0.84	9.06	8.89
1038	0	0	1.8	0.94 ± 0.21	5023	229		0.16	8.92	8.66
1039	0	0	2.6	0.85 ± 0.29	4860	208	m	1.40	8.87	8.73
1044	0	0	1.9	0.22 ± 0.12	6850	63	m	0.64	8.58	8.25
1047	0	0	5.0	<0.63				2.14	<7.93	<8.08
1047	-24	-25	5.6	<0.71						
1047	24	35	5.6	<0.71						

Table 3. Comparison of the Kitt Peak observations with those available from other telescopes.

KIG	<i>a</i>	<i>b</i>	$I(\text{CO})_{\text{KP}}$	$I(\text{CO})_{\text{lit}}$	θ_{lit}	Ref.	$(\theta_{\text{lit}}/\theta_{\text{KP}})^2$	expected $I(\text{CO})_{\text{KP}}$	CO distribution
(1)	(2)	(3)	K km s ⁻¹	K km s ⁻¹	arcsec	(7)	(8)	K km s ⁻¹	(10)
4	3.5	0.9	5.71 ± 0.33	9.49 ± 1.44	45	2	0.67	6.35	point-like
547	2.0	1.4	0.65 ± 0.16	2.58 ± 0.91	45	2	0.67	1.73	point-like
652	1.9	1.4	1.45 ± 0.50	3.20 ± 0.38	43	1	0.61	1.96	point-like
906	1.9	0.3	2.10 ± 0.50	2.30 ± 0.52	43	1	0.61	1.41	extended
850	3.8	1.9	11.40 ± 0.36	10.00 ± -	55	3	1.00	10.00	extended
850	3.8	1.9	11.40 ± 0.36	30.00 ± 5.80	33	4	0.36	10.80	extended
850	3.8	1.9	11.40 ± 0.36	13.80 ± 1.67	43	2	0.61	8.44	extended

Column 1: KIG name.

Columns 2 and 3: major and minor optical diameters, in arcmin.

Column 4: $I(\text{CO})$ intensity and error at Kitt Peak.

Column 5: $I(\text{CO})$ intensity and error at other telescopes.

Column 6: beamsize of the telescope.

Column 7: references: 1: SEST observations (this work); 2: FCRAO (Young et al. 1995); 3: Kitt Peak (Solomon & Sage 1988); 4: Onsala (Elfhag et al. 1996).

Column 8: ratio of the mapped areas.

Column 9: expected $I(\text{CO})$ intensity in a 55 arcsec beam for a point-like source estimated from CO data available in the literature, $expected\ I(\text{CO})_{\text{KP}} = I(\text{CO})_{\text{lit}} \times (\theta_{\text{lit}}/\theta_{\text{KP}})^2$.

Column 10: expected CO distribution.

KIG 652 gives $I(\text{CO}) = 1.45 \pm 0.50\ \text{K km s}^{-1}$, while the SEST one $I(\text{CO}) = 3.20 \pm 0.38\ \text{K km s}^{-1}$. For KIG 906, Kitt Peak observations gives $I(\text{CO}) = 2.10 \pm 0.50\ \text{K km s}^{-1}$, while the SEST one $I(\text{CO}) = 2.30 \pm 0.52\ \text{K km s}^{-1}$.

Three galaxies of our sample have published CO data:

KIG 4, NGC 7817: our Kitt Peak observation gives $I(\text{CO}) = 5.71 \pm 0.33\ \text{K km s}^{-1}$, while Young et al. (1995), using the FCRAO 14.7 m telescope, obtained $I(\text{CO}) = 9.49 \pm 1.44\ \text{K km s}^{-1}$ (main beam scale) in the central position.

KIG 547, NGC 4635: our Kitt Peak observation gives $I(\text{CO}) = 0.65 \pm 0.16\ \text{K km s}^{-1}$, while Young et al. (1995), still with the FCRAO 14.7 m telescope, obtained $I(\text{CO}) = 2.58 \pm 0.91\ \text{K km s}^{-1}$ (main beam scale).

KIG 850, NGC 6643: three independent measurements are available in the literature: Young et al. (1995), with the FCRAO 14.7 m telescope, obtained $I(\text{CO}) = 13.80 \pm 1.67\ \text{K km s}^{-1}$, Solomon & Sage (1988), with the Kitt Peak 12 m telescope, measured $I(\text{CO}) = 10.0\ \text{K km s}^{-1}$, and Elfhag et al. (1996) $I(\text{CO}) = 30.0 \pm 5.8\ \text{K km s}^{-1}$ using the Onsala 20 m telescope. These values (all given in main beam scale) must be compared with our Kitt Peak observation $I(\text{CO}) = 11.40 \pm 0.36\ \text{K km s}^{-1}$.

A direct comparison of the various sets of data is not straightforward because of the different beam sizes of the telescopes ($HPBW = 55$ arcsec for Kitt Peak, 43 arcsec for the SEST, 45 arcsec for the FCRAO and 33 arcsec for Onsala). The two independent observations of KIG 850 carried out with the same telescope give consistent results within 15%. As shown in Table 3, the other sets of data are consistent with ours for a point-like emission in the galaxies KIG 4 and 652, and for an extended and radially declining emission in KIG 906

and 850⁴. The only inconsistent data are that of KIG 547, whose $I(\text{CO})$ intensity measured at Kitt Peak is too small compared to that obtained at the FCRAO even in the case of a point-like CO distribution. We thus conclude that our observations are generally consistent, within the errors, with those available in the literature.

4.3. Statistical properties of the sample

Since the physical properties of the ISM strongly depend on the metallicity and on the UV radiation field, the use of a constant CO to H₂ conversion factor is no more justified for a sample of galaxies spanning a wide range in morphological type (from giant spirals to dwarf irregulars) and luminosity ($-21.2 \leq M_B \leq -17.3$) as the one observed in this work (Boselli et al. 2002). As shown by Boselli et al. (2002), in this luminosity range X varies by a factor of ~ 5 . To avoid any systematic bias, the statistical properties on the molecular gas content of this sample of galaxies can be estimated only using a luminosity dependent conversion factor. Indeed the molecular

⁴ All sources are undersampled in both sets of observations. Because of dilution effects, for sources whose CO emission is less extended than the angular dimension of the smaller beam (here defined as point-like sources), the CO intensity observed in the larger beam (Kitt Peak observations) should equal that observed in the smaller beam multiplied by the ratio of the smaller to larger mapped areas. In CO extended sources, independently on the CO distribution within the disc of the galaxy, the CO intensity observed in the larger beam overcomes that observed in the smaller beam multiplied by a similar geometrical correction factor.

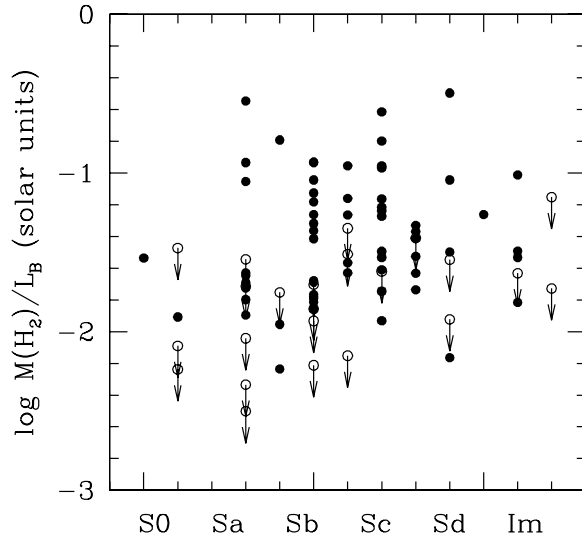


Fig. 2. The molecular gas mass to optical blue luminosity of the target galaxies. Filled symbols are for detected galaxies, arrows are upper limits to the $M(\text{H}_2)/L_B$ ratio (CO undetected galaxies).

gas mass determined assuming a constant CO to H_2 conversion factor is overestimated in massive, early-type spirals, and underestimated in low-luminosity, dwarf galaxies.

Assuming a luminosity-dependent CO to H_2 conversion factor we can trace the molecular gas mass to optical luminosity ratio (Fig. 2) and the molecular to atomic gas ratio (Fig. 3) vs. morphological type of the sample galaxies.

The molecular gas mass to optical luminosity seems to increase from early-type to late-type spirals, consistently with what observed by Boselli et al. (1997) using H band luminosities⁵.

Consistent with Boselli et al. (2002), we find that in the isolated galaxy sample the molecular gas fraction is $\sim 18\%$ of the HI gas (if upper limits are treated as detections).

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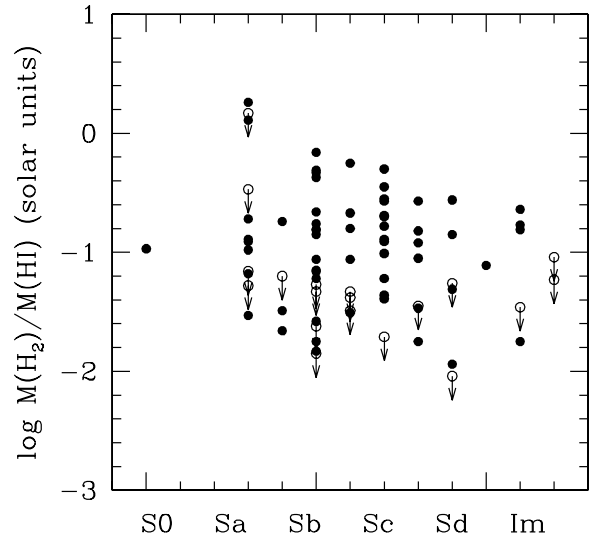


Fig. 3. The molecular to atomic gas mass ratio as a function of the morphological type. Filled symbols are for detected galaxies, arrows are upper limits to the $M(\text{H}_2)/M(\text{HI})$ ratio (CO undetected galaxies).

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⁵ The H band luminosity, compared to the B band luminosity, is unaffected by dust and by recent events of star formation and is a direct tracer of the total mass (Gavazzi et al. 1996).